The

SCIENTIFIC AMERICAN

DIGEST

SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

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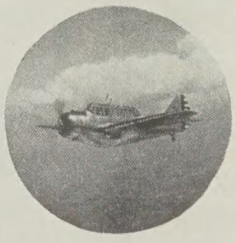

In the article starting on page 5 of this issue is given a compact survey of the world's finest warplanes—those employed by the Air Services of the United States. On our cover is illustrated the North American observation plane, O-47A. Note the windows in the lower part of the fuselage and the full-vision cockpit enclosure. The eyes of the Army must see all.—*Official Photograph, U. S. Army Air Corps.*

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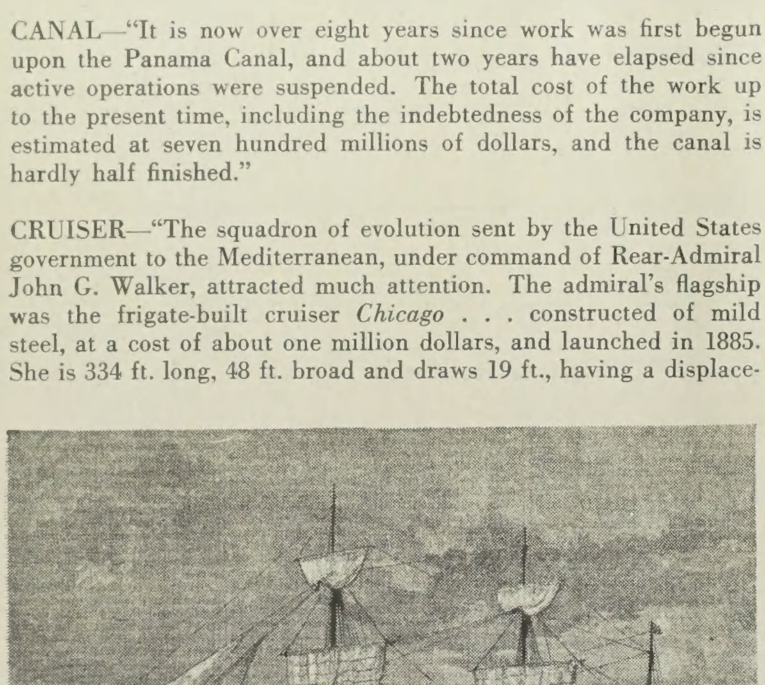
50 Years Ago in . . .

Scientific American

(Condensed From Issues of July 1890)

CANAL—"It is now over eight years since work was first begun upon the Panama Canal, and about two years have elapsed since active operations were suspended. The total cost of the work up to the present time, including the indebtedness of the company, is estimated at seven hundred millions of dollars, and the canal is hardly half finished."

CRUISER—"The squadron of evolution sent by the United States government to the Mediterranean, under command of Rear-Admiral John G. Walker, attracted much attention. The admiral's flagship was the frigate-built cruiser *Chicago* . . . constructed of mild steel, at a cost of about one million dollars, and launched in 1885. She is 334 ft. long, 48 ft. broad and draws 19 ft., having a displace-



ment of 4,500 tons. She has two screw-propellers, with engines of 5,500 horse power, indicated; the machinery is protected by a partial steel deck. Her speed is 15 knots an hour, and she carries 940 tons of coal. The armament consists of four 8 in. breech-loading guns, on the spar deck; eight 6 in. breech-loading guns, in broadside, on the gun deck; and two 5 in. breech-loading guns aft; with six machine guns."

GUNPOWDER—"No evidence exists of the use of gunpowder as an agent of warfare until the middle of the twelfth century, nor did a knowledge of its propulsive effects come to the Chinese until the reign of Yunglop in the fifteenth century — a thousand years after its first employment in fire crackers."

GLASS—"A new method of obtaining stained glass is done by a process of printing. The design is embossed on an iron plate, on which a lump of hot glass is rolled until it takes the form of the plate on which the pattern is cast. The sunken lines are then filled with enamel and the whole plate is fired. This process obviously does away with the use of leads, is rapid in its execution, and has the additional advantage that the design may be repeated as often as it may be required."

TOOTHPICKS—"Quill toothpicks come from France. The largest factory in the world is near Paris, where there is an annual product of 20,000,000 quills. The factory was started to make quill pens, but when these went out of general use, it was converted into a toothpick mill."

GIRDER—"The Keystone Bridge Co. has just completed a girder for the new City Hall of San Francisco, which is the largest ever made in the United States. . . It is 105 feet long, and weighs 70 tons. A contract for two girders was given to the company last November, and they have been working on it ever since. The materials for the second one are now being prepared. The girders are intended for the ground floor of the building."

WELDING—"The great demand for artificial ice machines, and the necessity for furnishing long coils of pipe to be used in their construction, has furnished a new and extensive field for the pipe welding machines of the Thomson Electric Welding Company. The difficulty of welding pipe by the old methods is that, unless the joints are perfect, there is an escape of ammonia vapor which renders them practically useless. It is found that by the electric welding process these joints are perfect, and lengths of 400 or 500 feet of homogeneous pipe can be made without difficulty. The electric welds stand bending either hot or cold."

FOOD—"Probably no modern science presents a wider field for speculation than that of chemistry, and more especially, perhaps, that branch of the science which treats of organic compounds. . . In an address delivered at Heidelberg, by no less eminent an authority than Victor Meyer, it is announced that 'we may reasonably hope that chemistry will teach us to make the fiber of wood a source of human food.' What an enormous stock of food, then, will be found, if this becomes possible, in the wood of our forests, or even in grass or straw."

PAY-TELEPHONE—"A novel telephone station is being introduced in Connecticut. The instrument cannot be used unless a fee is paid. There are five slots in the machine for the reception of a nickel, ten cent piece, quarter, half dollar, and dollar respectively. . . To use the telephone it is first necessary to call up the central, as on an ordinary telephone. The objective point is then asked for, and when this is reached, the party who rings up is told to put the necessary fee in the slots."

SPEED—"A special train . . . on the 15th July . . . left Baltimore at noon, and thirty-five minutes later had traveled forty-two miles and was in the Pennsylvania railroad station in Washington. The speed averaged 72 miles an hour, or allowing for starting and stopping, at least 80 miles for the greater part of the run."

AND NOW FOR THE FUTURE

¶ Progress in the young and vigorous organic chemical industry. By Dr. C. M. A. Stein.

¶ Geriatrics — the newest medical specialty. By Barclay Moon Newman.

¶ Pattee's Caves, where medieval Irish monks may have lived in New England. By Prof. Hugh O'Neill Mencken.

¶ Evolution in the future: Will the human species ultimately produce a race of super-men? By Henry M. Lewis, Jr.

¶ Brilliant achievement in the improvement of commonplace textiles. By Philip H. Smith.

Personalities in Industry

BORN in Brooklyn, New York, in 1892, Donald W. Douglas was 11 years old when the Wright Brothers made their first flight at Kitty Hawk. Six years later he received his appointment as a midshipman in the United States Navy and was ordered to report to Annapolis. In 1909 the two American inventors of the flying machine brought their frail biplane to Fort Meyer, Virginia, for a demonstration to the United States Army. Young Douglas was among the few who saw the airplane leave the ground, fly around the course and return to its starting point. He did not know it then, but that event also marked the beginning of his career.

After three years of training cruises, navigation, and mathematics, young Douglas still had his mind on wings and skies instead of the seven seas, and was ready to turn to new, untried fields. His father, William E. Douglas, a New York banker, hoped Don would become a naval officer, but fate and Donald decreed otherwise. In 1912 he entered the Massachusetts Institute of Technology. His progress at the Institute was rapid. He was graduated in 1914 and in June of the same year received an appointment at that institution as Assistant in Aeronautical Engineering at a salary of $500 a year. It was his first job in aviation.

With Commander J. C. Hunsaker, young Douglas worked on the first wind tunnel, a step that laid the foundation for the amazing development of aviation in the last quarter of a century. In 1915 he joined the Connecticut Aircraft Company in New Haven as a consultant and there worked on the D-1, the first dirigible built for the United States Navy. Later in 1915 Douglas went to Glenn L. Martin and became his Chief Engineer. Within a year he was Chief Designer for the Aviation Section of the Signal Corps, but later returned to Martin. At 25 he was one of the outstanding men in the fascinating new field of aeronautics.

By 1920 Donald Douglas was working for himself. He came to southern California and with David R. Davis formed the Davis-Douglas Co. Their first office was "desk space" in a barber shop. There was designed the Douglas *Cloudster*, the miracle of its day. It was only a step from the *Cloudster* to a Navy contract for several airplanes.

In four years Douglas was ready for another milestone in his career. A new model, the *DWC* was finished and the United States Army was on its way to make its historic flight around the world by air. The Douglas slogan became "First Around the World," and today is "First Around the World—Now the World Over."

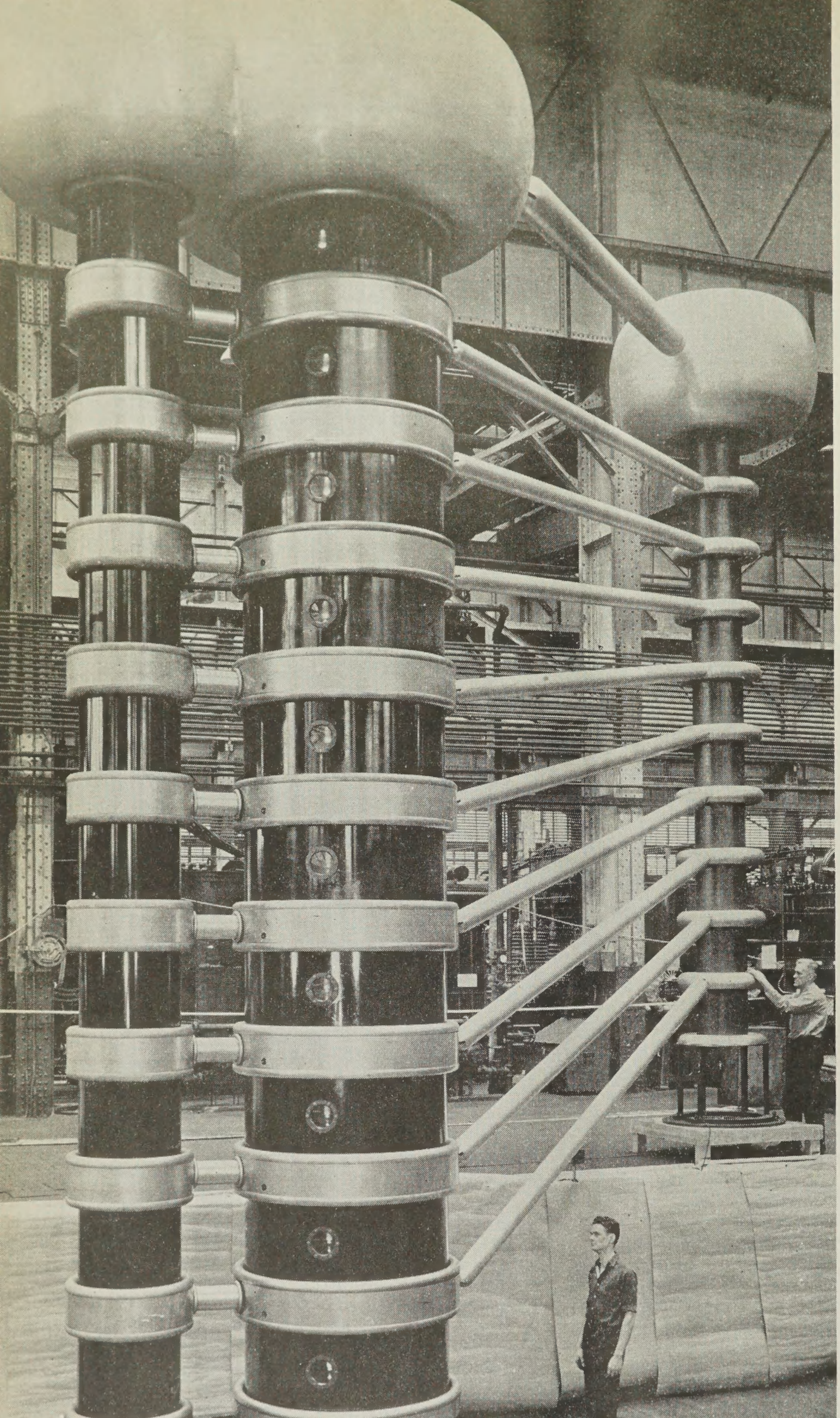
DONALD W. DOUGLAS

At the age of 32 Donald W. Douglas was internationally famous. His organization grew until today the two Douglas factories at Santa Monica and El Segundo, California, are America's largest airplane plants. On May 1, 1940, Douglas employed over 17,000 men and women, with a payroll of approximately $28,000,000.00.

In 1932 Douglas entered a new field. The historic *DC-1* and the *DC-2* changed aerial transportation in America. Soon Douglas airliners were dominating the skies. The 425th ship of the "DC" series was delivered in May, 1940. Douglas airliners fly more than 350,000 miles every 24 hours in the United States and 22 foreign countries. To the safety record of 1939, when the airlines in the United States carried 2,000,000 passengers 815,000,000 miles without an accident, Douglas contributed equipment for 85 percent of this imposing record.

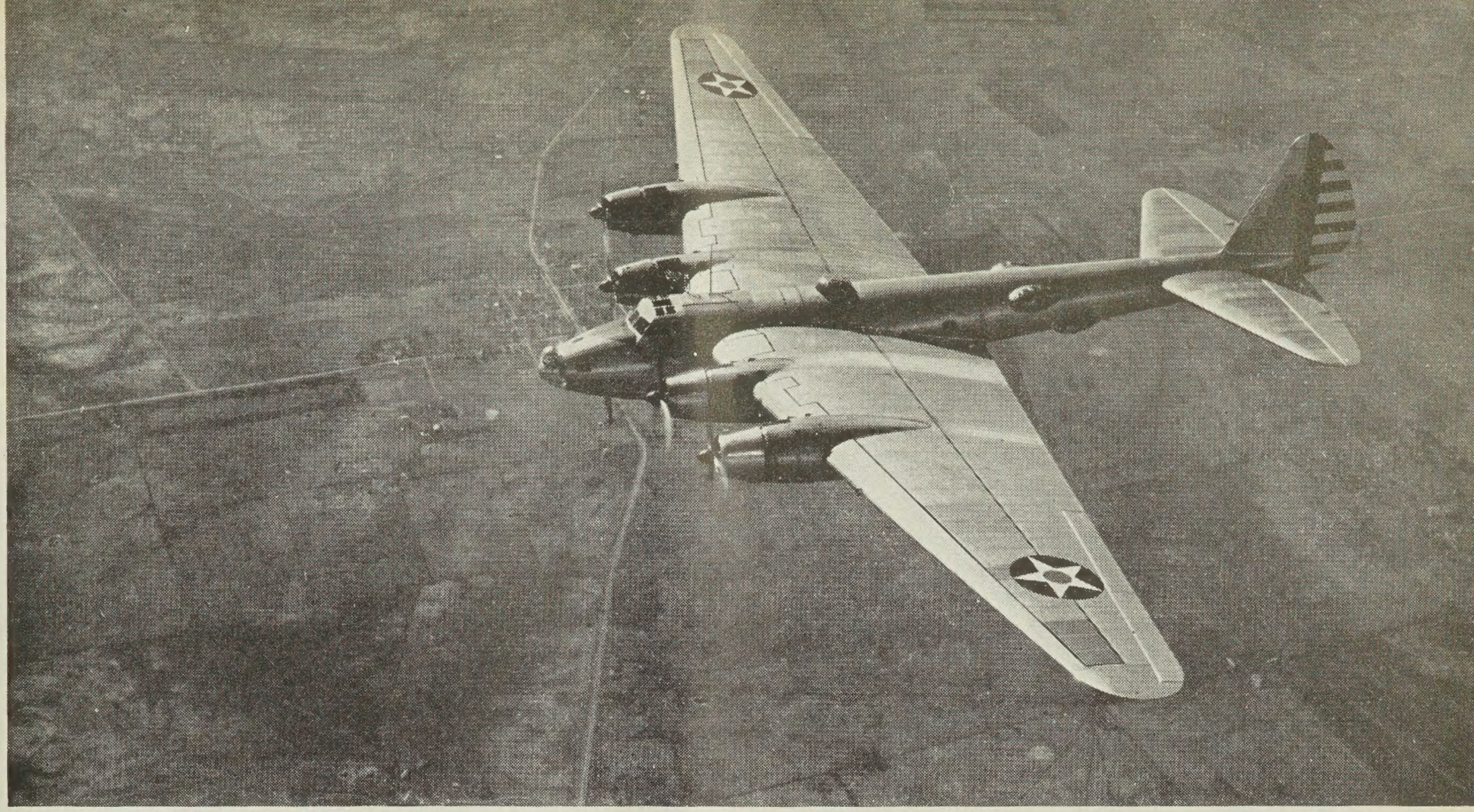
Universal acclaim and recognition made no change in Don Douglas. In 1936 when President Roosevelt presented him the Collier Award for outstanding advance in aviation, his associates still called him "Doug," as they did after he received, in January, 1940, the Guggenheim Gold Medal for the outstanding contribution to the development of commercial and military airplanes.

He is married and lives with his wife and children in Santa Monica, close to the huge Douglas plant. Reading, yachting, and quiet hours with a few close friends are his recreation. Never flustered, seldom disturbed, always calm and collected, he continues to keep pace with the amazing progress of the thing closest to his heart—aviation.



THE WORLD'S MOST POWERFUL X-RAY APPARATUS

THREE principal objects in this group are, at right, a 1,400,000-volt X-ray tube; in center, a high-voltage generator to feed it; at left, resistance units. General Electric has built this big apparatus for the National Bureau of Standards, which will use it, first, to explore X-ray dosage at the higher voltages into which medicine is pushing, later for producing neutrons and artificial radioactivity for physical research. The 1,400,000-volt, 10-milliampere X-ray tube is composed of ten sections of 140,000 volts each, in cascade; each section is fed individually by its corresponding section of the ten-part generator. This is composed of step-up transformers, capacitators, and kenotron rectifier tubes. Resistance units in left-hand stack are used in measuring the voltage. X-ray tube is 28½ feet high, and its beam of electrons travels 24 feet. In operation these electrons start at zero velocity and are given a velocity kick in each section, so that at the target the speed is 180,000 miles per second—very nearly the velocity of light. Curved tops of each stack are spun aluminum corona shields to prevent loss of electricity to the atmosphere.



Official photograph, U. S. Army Air Corps

A Boeing flying fortress, world's largest service ship, which will be dwarfed by a 72-ton ship now building

America's Winged Weapons

World's Finest Warplanes . . . Built to High Standards and of Superior Material . . . What the Various Types are Designed to Accomplish

By JAMES L. H. PECK
Author of "Armies With Wings"

An embittered Spain, a disunited Poland, and a capitulated Finland bear mute testimony to potency of modern airpower; what remains of the Old World appears destined to suffer at the hands of this new weapon—swiftest, most far-reaching of Man's war agencies. And all of this has a very definite effect upon American defense in general and our air arm in particular.

The sleek warplanes, which are literally the sinews of this American air arm, are much in the news these days; current discussion is international as well as national. These fighting craft are of several types, each of which is designed for one of the tactical sub-divisions of our Army Air Corps or Naval Air Service. The tactical branches of the former include pursuit, attack, observation, and bombardment. Naval branches are somewhat similar, and comprise fighter, scout-observation, patrol, and bombing squadrons. The small but colorful Marine Corps flying organization is an integral part of the Navy Bureau of Aeronautics, and their equipment is of essentially the same pattern.

Fighters and pursuit-interceptors are the smallest of combat craft, their tactical function entailing the destruction of enemy bombers and combat ships. The designation "interceptor" has been applied to American planes only recently, although England has, for many years, employed single- and multi-seater planes of this type. Its primary use is to fly up and out to intercept approaching hostile planes. The interceptor is usually designed for extremely fast climbing and is heavily armed. Fighters and pursuits are usually more maneuverable, and engage in close and rapid in-fighting while the interceptors indulge in hit-and-run tactics. The new Air Corps pursuit-interceptors are single-seaters, having four machine guns and aerial cannon mounted stationary within the wings or the cowl in front of the pilot's cockpit. The ships are aimed and flown at the target, while the guns are fired automatically by hydraulic or electric devices, the triggers being mounted handily on the ship's control sticks.

The much-publicized Bell P-39 "Airacobra" and Vultee "Vanguard" are typical prototypes. The Bell YFM-1 "Airacuda" and Lockheed P-38 are twin-engined craft of somewhat larger dimensions; the former being our only multi-seater (five-man) fighter. The newest models are the Curtiss P-42 and P-46 and the Navy's Brewster F2A-2. All of these sparkling craft are superior to any in the world in their respective classes—which is why the Anglo-French Purchasing Commissions are not exactly unhappy.

Combat planes are evaluated in terms of their performance—how fast they fly at both cruising (with 60 to 75 percent full power) and top speeds, how easily and rapidly they may be maneuvered through the aerobatics occasioned by combat, and how quickly they can take off and climb to high altitudes to meet the enemy. In addition, they must have a high "factor of safety" and good flying characteristics in general, with safe landing and take-off abilities in particular.

This behavior, however, is but a means to an end. High speed is essential mainly for the purpose of overtaking or escaping enemy craft; a rapid rate of climb, to get the defending planes up to the altitude of the approaching ones; and maneuverability, for the sole purpose of outflying hostile ships so that the guns—"firepower"—may be brought to bear. No warplane is any more effective than its armament, and the successful employment of this, in turn, depends upon the man behind the gun.

None of the World War II warplanes

rank so high on *all counts* as do our new pursuit-interceptors, two of which are some 70 miles faster than any Nazi ship known to be in service, and four of which will climb to 10,000 feet in far less time than Britain's "Spitfire," topmost World War II climber.

Planes of the attack branch are designed for assaults on ground troops and matériel in a low-flying operation called "strafing," employing machine-gun fire, small and medium-sized bombs (30 to 100 pounds), and contaminating chemicals. After using attack planes which were slightly larger than pursuits for several years, the Air Corps has found the 60-foot, twin-engined attack bomber more satisfactory. These "winged tanks" carry more fuel and bombs than the smaller attack plane, and this added gas capacity permits them to accompany larger bombers on a mission far beyond the cruising range of the former type. The two motors make for increased speeds and also provide better forward visibility for the pilot. This is paramount when flying 400 miles per hour at tree-top altitude! The new Douglas A-20A almost attains this pursuit-plane speed with a full warload of bombs, fuel, and war chemicals. Although this ship, the Martin 167W, and North American NA-40A, carry crews of from three to five men, the forward-firing guns, which are mounted in the wings, are fired by the pilot in the same manner as those on a pursuit plane. A rear gunner holds forth in his enclosed turret to ward off would-be back-biters, and the bombardier bombs from his vantage point in the ship's nose.

Encamped troops, or those who are marching, are easy prey of attack bombers, and these ships support friendly infantry advances by strafing enemy trenches, artillery, and machine gun emplacements. A most important mission, however, is the support of bombing operations, wherein it becomes the strategy of the attack planes to "neutralize" or destroy the anti-aircraft batteries which protect the objectives sought out by their big brothers, the medium and heavy bombers. The low-flying onslaught enables the attack bombers to flash from behind terrain features and trees upon the unsuspecting victims with the element of surprise and blinding speed in their favor. Anti-aircraft gunners who are being harassed by parachute bombs and mustard spray are practically helpless for all their marvelous fire-control gear; all of which makes the attack-bomber the most deadly thing on wings.

THE air raider's tactical function is to bomb to destruction such enemy objectives as air bases, power stations, reservoirs and pumping stations, shipping and docks, mills, factories, and other sources of matérial and food supply, communications and transportation centers, troops and fortifications—most of which are to be found within city limits and necessarily involve the military and the helpless alike.

Heavy bombers, such as our Boeing flying fortresses, are designed to carry huge fuel and bomb loads for long distances. A six- or eight-man "combat crew" comprises pilot, co-pilot, bombardier, radioman, navigator, and gunners, most of whom are quite versatile in that they can exchange places and jobs when necessary. These types are four-engined monoplanes having machine guns disposed about the huge ship in such a manner as to provide defensive fire from all angles. The Air Corp's Douglas B-19, now building, weighs 72 tons and has a cruising range that will permit a round trip flight between New York and Paris.

However, not all bombardment missions call for long-distance flying, and because of the poor strategy involved in employing the long-range bomber for not-so-long operations, the fortress' little brother, the medium-bomber, came into being. This is a twin-engined monoplane which is smaller and faster, and carries less warload over shorter distances.

Because of the diversification of Navy bombers, a word is timely regarding the "egg-layers" of the flying fleet. In lieu of the heavy bomber, the Navy employs a 13-ton patrol bomber of the now famous Consolidated PBY type which gained popularity through the record-breaking formation flights to Hawaii and the Canal Zone sometime ago. These are twin-motored monoplane flying boats. The boats of Patrol Wing Five are conducting the Neutrality Patrol

Official photograph, U. S. Army Air Corps

Rated as the world's fastest pursuit-interceptor, this Lockheed P-38 has two 1150-horsepower engines

Official photograph, U. S. Army Air Corps
Note the wing guns in this Martin 167 attack-bomber. Top speed is 355 miles per hour

off the Atlantic coast. These are the aerial cruisers of the fleet, and with their formidable range the PBY boats can fly hundreds of miles to spy out enemy ships.

The torpedo bomber is a single-engined, low-wing monoplane of about 50-foot wing span. These craft carry a 2000-pound torpedo and are carrier-based landplanes. In action, they skim just above the waves, headed straight for their floating target, release the "fish," then pull up and away before the explosion occurs.

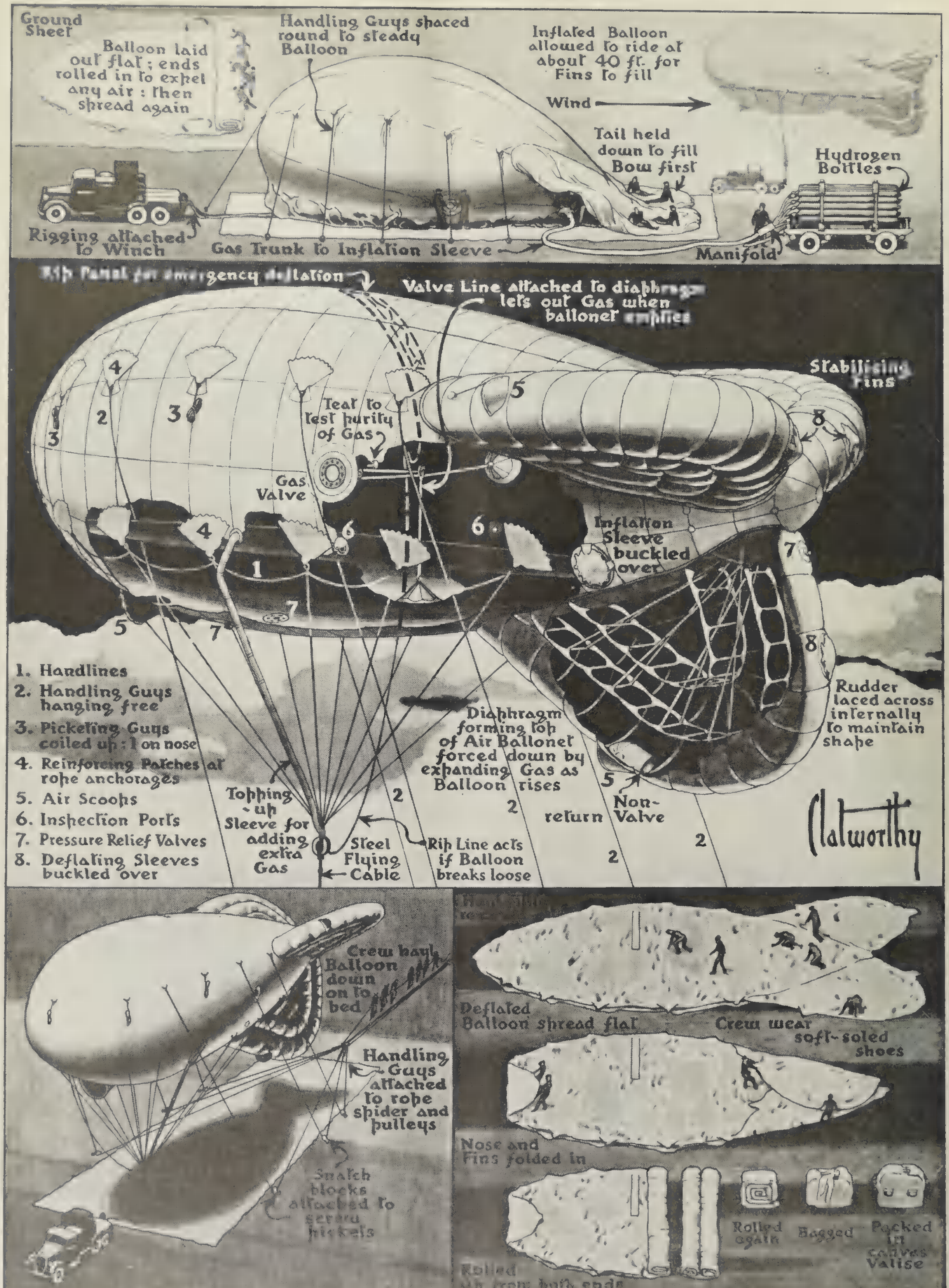
The scout-bombers and dive-bombers are smaller—the Curtiss SBC-4 "Helldiver" having a 34-foot span—and faster. The scout-bombers carry on short-distance reconnaissance, and when necessary they stop scouting and commence bombing. Both these prototypes employ the spectacular vertical dive attack, in which they scream down at around 400 miles per hour, aimed at the target, release their bombs, then pull up when about 500 feet above the sea.

Bombing teams—pilot and bombardier—of the patrol bombers and the Air Corps types lay their death eggs in a less spectacular method from higher altitudes. When the bombs are released from the racks in which they are suspended in the plane's belly, they do not fall straight downward, but travel forward with the ship for a distance before heading earthward in a parabolic trajectory. This behavior—that is, the forward movement from point of release—is called "range," and it varies with the plane's speed and altitude. From 6000 feet, a bomb would have a range of about a mile and a quarter if the bomber is flying 240 miles per hour; at the same speed, the missile would have twice this range—or 13,648 feet—if dropped from 12,000 feet. But range is only one of many considerations, and all these are neatly taken care of by the bomb sight. The bombardier makes settings to correspond to the plane's speed, altitude, wind drift, ground speed, and other technicalities, and sights down and ahead until the target is lined in the telescopic view finder, then merely presses a button. Electrical apparatus and science take care of everything. The miraculous accuracy of our Sperry sight is pretty well known by this time—both in and out of the United States!

OBSERVATION work is not so glamorous as that of the combat branches, but it is equally important. Aerial reconnaissance—the "eyes of the Intelligence"—is perhaps the most important original source of enemy information available to ground commanders. Flights over the hostile back areas, trenches, and cities, and the photos thereof, supply invaluable information of enemy movements. The North American O-47A, an all-metal, mid-wing monoplane, which is provided with a windowed belly for the observer and his all-important camera, is the current Air Corps observation plane.

Another unglorified branch which is employed by both the Army and Navy forces bears the simple title "Utility," but it is most essential to the smooth operations of the air forces. Cargo ships fly all sorts of equipment to air bases or outlying posts. Transports—which are largely of the Douglas DC-2 type seen at most airline terminals—are necessary for the rapid movement of personnel and staff officers. Ambulance craft have saved many a life by swift, comfortable transportation of injured personnel to a place where medical attention was available. The military version of the Douglas transports employed for these purposes is known as the C-39. Last, but far from least, come the vitally important training craft of "primary" and "basic" designations; two of the newer types being the Army's Vultee "Valiant" and the Navy's North American SNJ-2. Fledglings must undergo gradual, carefully supervised transition from these trainers to the speedy, tricky pursuits or giant bombers.

These are the world's finest warplanes; they fly faster and farther than any of the respective foreign types known to be in service or building, and they are built to higher specification standards and of superior material. Our services, unlike most of those across the water, believe as a matter of policy that American airmen are worthy of the finest airplanes that engineering ingenuity and money can provide—and we have more of both than any country in the world.



CREW OF TEN HANDLES A LONDON BARRAGE BALLOON

EFFICIENCY of the London balloon barrage has been proved by the unfortunate wrecking of two friendly airplanes since the war began. Such barrages have shown their effectiveness to discourage mine-laying by airplanes in estuaries. Each balloon requires a winch-truck and a trailer; and is made ready for flying by ten soldiers and a corporal.

OUR POINT OF VIEW

Who Ever Dares Say Never?

IT isn't safe any longer to assert that anything will "never" become possible. Since a long time ago every scientist has known that you never could expect to see clearly objects much smaller than about 1/100,000 inch in diameter, no matter how expensive a microscope you might devise. The watertight reason for this was the obvious one that a hundred thousandth of an inch was not far from the size of pattern of the very thing by means of which you did the seeing; that is, light. Things smaller were not properly noticed by the light to afford a clear image and there was nothing you could do about it. So we had reached the ultimate limit of working magnification at little more than 2000 diameters.

This permitted you, however, to see most of the disease germs. You could see them about as clearly as you can see and recognize a man standing off at some distance, with the naked eye; that is, you could see their general outline but not much of their detail. By wholly different methods than seeing, science could, of course, deduce and prove the existence of many things smaller, smaller, smaller, smaller, smallest, by several degrees of size, than germs; that is, disease viruses, large organic molecules, common inorganic molecules, atoms, parts of atoms. These proofs established the existence of such sub-entities just as fully as if you could see them—perhaps more so, since seeing isn't always believing. Yet you always felt that you wanted an actual look at these things and you were told that you would never get that look.

Today, thanks to the electron microscope so lucidly explained on another page by the young physicist, Jean Harrington, we expect soon to behold clearly, not, it is true, parts of atoms or even whole atoms, but the entities that stood next higher on the forever forbidden list; that is, viruses and large molecules—the latter have been seen already. The electron microscope at one jump has multiplied our power to peer into the vastness of the minute just about fifty times; it permits a magnification of 100,000 diameters! It would even permit us to see atoms if certain wide practical discrepancies between its theoretical and actual power did not still bar the way. Won't these "bugs" be disposed of? Some may. Yet the men who have wrestled with the problem in the flesh think the electron microscope never can come within five percent of its full theoretical resolving power. Some practical reasons are: human inability to attain perfect symmetry of parts, to a degree way past even fine machine work; tiny residual irregularities in coil windings; residual ripples in voltage control that cause variations in electron speed, though you control it, as RCA has, within three volts in 70,000; and, finally, the very same hard-boiled family of aberrations — chromatic, spherical and the others — that have always bedeviled glass lens design.

This super-microscope, which is now coming into its fruition stage after about a decade of difficult development, is the result of a combination of strategem with a great deal of invention, experiment, tenacity, and refinement of technique. Confronted by a blank wall, science made a flank movement. Since images of things far too small to fit the pattern of ordinary light were needed, resort was had to a kind of light having far finer texture—electron waves. Electron waves being invisible to our eyes, they were then transformed, by means of the substances on the fluorescent screen, into waves which our eyes could perceive. These substances can take in the electron energy, change it into light, and send it out again—visibly. And there, on that screen—for example, in the electron microscope at the Camden laboratories of the RCA—you can look into a glass-covered window and, with entire comfort—no squinting—see large greenish images of things magnified as man never before hoped to see them. It makes you feel a bit creepy. Here is a chain of streptococci linked together by a narrow waist, like the waists between linked sausages. It is molecular in size. Or a typhoid germ with flagella, like little whips, extending from it.

There are three important things in the biological world which for a long time have greatly annoyed scientists by being just too small to descry clearly in microscopes—the virus, the gene, and the bacteriophage. Viruses—known cause of measles, influenza, smallpox, infantile paralysis, yellow fever, and the common cold—have for some years been suspected of being either half alive living things or half alive chemicals. Will the electron microscope lead us to a better understanding of viruses and thus to a cure of the virus-caused diseases? Second, the gene, that hereditary factor in our cells which determines our physical and other characteristics. Will the new tool enable us to discover new facts that may ultimately make for better animals and plants—even human beings? Third, the bacteriophage, a sort of predatory germ—the germ's own germ—which kills bacteria. Medicine would greatly like to know just what this perplexing entity really is. Some scientists think it is as much smaller than a germ as a germ is smaller than an amoeba.

Finally, the electron microscope promises much of wealth-controlling value for industry. Probably there is no industry, using any kind of material, that will not ultimately profit by the deeper insight into the real nature of the materials it uses which the electron microscope is expected to provide. Examples are the rubber industry (rubber's complex molecules), the cement industry, the paint industry, and the colloidal metals' industry. Laboratory workers equipped with this new instrument can not merely count the number of particles of a given material, as has long been possible by ordinary optical microscopes and ultra-microscopes (which do not, however, resolve them into clear images), but now can actually see their all-important size, shape, and especially their uniformity or variety. Industry already is awake to this new implement. Some companies—the Eastman Kodak Company, for example—are already using electron microscopes of their own design.

It cannot be said yet, and it may never be true, that the electron microscope will be accessible easily to every man who would like to have one around home just to amuse himself. The instrument now placed on the market by RCA costs, with its 100 kv regulated voltage supply, $17,500. It weighs 700 pounds and stands ceiling high; it is no portable, vest-pocket apparatus. Nor could the average man use one without special training; for it would be about as difficult for him to steer as a temperamental wife. The thing examined must first be placed on a film of nitro-cellulose only 1/3,000,000 inch thick—literally next to nothing! Air must be evacuated from the whole interior, because the big atoms and molecules in it otherwise would obstruct the flying electrons and alter their necessary precision of path, just as a dense thicket of trees would obstruct a snowball fight. There is a delicate technique to be mastered before use.

This question of vacuum bears pointedly on a question we have several times heard suggested. "Why not make an electron telescope working on analogous principles?" To accomplish this it would be necessary to create and maintain a vacuum—a sort of "tunnel full of vacuum"—clear down through the earth's atmosphere to the instrument, and this would be such a tall order that the electron telescope will nev. . .—*A.G.I.*

THE CHEMICAL GIANT

Corrosive Sulfuric Acid . . . Indispensable in Peace and War . . . Used in Most Industries . . . Annual Production Runs into Millions of Tons

By WILLIAM H. WAGGAMAN
Chemical Engineer

THE present European conflict which threatens to engulf the world has been defined as a war of metal, petroleum, and high explosives. But war also demands one other product about which the average person knows very little. He is still less familiar with the part which it plays in manufacturing those weapons so essential in conducting modern warfare. Yet, without this product, we would be unable to turn out the huge tonnages of fabricated steel, prevented from producing the millions of barrels of refined oil and gasoline, and powerless to manufacture the immense quantities of high explosives demanded by war.

This product is sulfuric acid, a colorless, odorless, heavy liquid, the most useful of all manufactured chemicals—and also the cheapest. It is produced in such enormous quantities that, even under normal conditions, the annual output is measured in millions of tons and, under war conditions, its production must be stepped up sharply to meet the increased demand.

TABLE I
Sulfuric Acid Consumption in the United States by Industries, 1938

	Short Tons
Fertilizer	2,100,000
Petroleum	1,120,000
Iron, Steel, & Metals	850,000
Chemical	790,000
Coal Products	585,000
Paints and Pigments	430,000
Rayon and Film	310,000
Explosives	185,000
Textile	90,000
Miscellaneous	300,000
TOTAL	6,760,000

The only sulfuric acid which most of us have seen is that contained in the battery of our automobile. We know this acid vaguely as a highly corrosive chemical which forms bluish green incrustations on the main cables leading from this storage battery, and that it will burn our hands and eat holes in our clothes if we happen to get splashed. "Oil of vitriol," as concentrated sulfuric acid is commonly called, conjures up visions of a destructive product—and it is just that. The main reason why we are so unfamiliar with this acid is that it seldoms appears in the final product which it is instrumental in manufacturing.

As is the case with almost every essential product entering into our complicated system of civilization, the United States leads the world in production of sulfuric acid. Within a period of 27 years—1889 to 1916—our annual output of this chemical increased over 700 percent. According to the latest figures of the U. S. Bureau of Mines, we produced, in 1938, 6,760,000 short tons, having a value of approximately $67,-600,000. This acid was distributed to the various industries as shown in Table 1.

The most recent figures available showing how the various nations compare in respect to their output of this acid are those of 1937, when their proportion of the world's total production was as itemized in Table 2.

WAR and preparation for war are reflected in the figures for Japan and Germany, since these two nations stepped up their production enormously during the past few years. Yet, in spite of the fact that we were at peace with all countries, the United States produced nearly one third of the world's total sulfuric acid in 1937, and twice as much as our nearest competitor, Japan, which was operating its plants at capacity in a feverish effort to end the "little Chinese Incident." Should we be drawn into war, our normal output of this chemical could be quickly increased by 50 percent.

Sulfuric acid is a compound of sulfur, oxygen, and water. Since water and the oxygen in the air are free, the chief raw material which must be purchased is sulfur or a sulfide ore (pyrites) containing sufficient sulfur to support combustion.

While sulfur is now obtained as a by-product in a number of industrial processes, most of the European countries are still dependent on outside sources for a considerable portion of their requirements. Yet it is an interesting fact that a few of the nations ordinarily classed among the "Have Nots," are well supplied with either sulfur or pyrites. Spain, Portugal, Greece, and Norway have large reserves of pyrites, and 40 years ago Italy was the world's chief source of elemental sulfur.

Since France is close to the inexhaustable supplies of Spanish pyrites, and Great Britain controls the seas, the Allies are assured adequate supplies of sulfur, and can probably prevent Germany from obtaining sulfur through her main ports. On the other hand, as long as the Rome-Berlin Axis endures, and Stalin remains Hitler's friend, Germany may be able to obtain sufficient sulfur from Italy and Russia to meet her needs, provided, of course, she has the cash to purchase it.

The United States, however, not only possesses immense reserves of pyrites, but the sulfur deposits of Louisiana and Texas are the greatest yet discovered, and the annual output from these fields eclipses that of all other nations combined.

When sulfur burns, it combines with the oxygen of the air to form sulfur dioxide, a stifling, choking gas, the odor of which is familiar to those who have fumigated their homes by means of sulfur candles. Sulfur dioxide is capable of combining with a further quantity of oxygen, but it requires a little "urging." Therefore a third party, known in chemistry as a "catalyst," is employed to introduce this additional atom of oxygen into the compound. The product thus formed is known as sulfur trioxide which, in turn, readily combines with

TABLE II
Production of Sulfuric Acid, 1937

Table compiled from figures of the U. S. Department of Commerce, and the "Chemical Trade Journal")

France	6.86 %
Germany	12.78 "
Italy	6.56 "
Japan	15.60 "
Russia	*7.53 "
United Kingdom	6.86 "
United States	31.00 "
All other countries	12.81 "
TOTAL	100.00 %

*Production of 1936

water to form the useful sulfuric acid.

Most of the sulfuric acid is manufactured in immense lead chambers, but the pure concentrated product is made in more compact plants. While most of the sulfuric acid plants have been built for the prime purpose of manufacturing this chemical, others have been erected to recover this acid as a by-product. And this brings us to a strange story of how our annual output of acid was *unwillingly* increased by 1,000,000 tons.

Many metal-bearing ores contain rather high percentages of sulfur; and in roasting or smelting such material to recover the metal values, immense volumes of sulfur dioxide were released into the atmosphere. Now sulfur dioxide is a rather heavy gas and quite toxic to vegetation. It gradually settled down on farms and ranches, even though they were miles away from the smelters, and caused grave damage to crops. The blame was traced to the smelters, and injunctions were secured whereby their owners were given the choice of either collecting the noxious sulfur dioxide or closing down the plants. They chose the first course and, although it involved heavy expenditures, they erected immense plants and turned the waste gases into sulfuric acid. Instead of proving an added expense or liability, the acid collected more than paid for itself, so that in some instances it is hard to say which should now be considered the main product—metal or sulfuric acid.

Fertilizer is made in this plant, of which only a part is shown, by treating phosphate rock with strong sulfuric acid

Under normal conditions, the production of this acid is a better index to a nation's prosperity than its output of steel and agricultural commodities, for sulfuric acid not only contributes liberally towards the production of these basic materials, but it plays an almost indispensable part in the manufacture of the innumerable things which are in such demand when times are good. As an example, the year 1928 probably represented the peak of post-war prosperity; and we produced in that year 7,225,000 tons of sulfuric acid. But, in 1932 when we were in the depths of the greatest financial depression of all time, our output of this acid dropped to 4,401,000 tons, a decrease of about 40 percent.

The fertilizer industry is the greatest consumer of sulfuric acid, and the larger fertilizer plants usually have an acid factory as part of their equipment. In 1938, this industry required over 2,000,000 tons of sulfuric acid and it was by no means being operated at capacity, or tonnage would be greater.

The next largest consumer of sulfuric acid is the petroleum industry. This acid is practically indispensable in the refining of oil, kerosine, and gasoline; yet here again, no trace of free acid is allowed in the finished products as it would soon ruin the delicate mechanism of the carbureter and score the cylinders of our automobiles. In 1938, 1,120,000 tons of sulfuric acid were consumed by different parts of the petroleum industry.

The next greatest demand for sulfuric acid comes from the metallurgical industries. Our huge output of metal products would be impossible without its aid. Mining operations could not be carried on as extensively or cheaply without the help of the high explosives which sulfuric acid is instrumental in producing; and after the various metals are separated from their ores, sulfuric acid is employed in ridding the surfaces of scale before these metals can be fabricated into such finished products as wire, bars, sheets, pipe, and tubing. This acid plays an important rôle in the manufacture of electrolytic copper, galvanized iron, and nearly all types of plated metal. If we had deprived the metal industries of the 850,000 tons of sulfuric acid consumed in 1938, business would have been at least partially paralyzed.

Until comparatively recent times, sulfuric acid was instrumental in producing many of the other important acids used in the arts and industries. Although we have discovered other means of producing these acids, the demand for sulfuric acid shows no tendency to decrease, for new uses are constantly developing elsewhere. It is the main power behind the chemical industry. The consumption of this acid for chemical and medicinal purposes in 1938 amounted to 790,000 tons.

Without sulfuric acid, the movie industry would be prostrated until development of some substitute to take its place in the production of the millions of miles of photographic films required. The manufacture of one type of rayon would cease, and the candid camera would be relegated to the attic. In 1938, 310,000 tons of sulfuric acid were employed in the manufacture of rayon and cellulose films.

In the home, sulfuric acid has been instrumental in producing the heating plant, and the steel work, the steam or hot water pipes, so necessary in this system. Sparkling clearness of faucet water is probably due to a compound of sulfuric acid, (alum), which is introduced at the filtration plant to precipitate or throw out suspended impurities. This same acid has had a hand in the manufacture of keen edged razor blades, and is responsible in part for the chromium plated fixtures of the bath room.

Soap, made by the so-called "English process," and shoe polish, whether black or white, have probably been manufactured by the aid of this chemical.

Without sulfuric acid there would be no family car. Practically every part of the modern automobile, (with the exception of the glass), has been manufactured by the aid of this chemical. The steel of the body, as well as the numerous metal parts, must be "pickled" in sulfuric acid before the finish is applied. The nitro-cellulose lacquer is produced through its agency, and the chromium plating also involves its use. Even the upholstery, whether it be of wool or artificial leather, has been produced by the aid of sulfuric acid or its derivatives.

We owe our thanks to sulfuric acid for the enamel-ware in the kitchen, certain ornaments in the living room, many of our paints and pigments, and for numerous dyes which impart beauty to the textiles used throughout the home. The cans on the pantry shelf have been manufactured by the aid of the acid.

Devoutly do we hope that American-made sulfuric acid need only serve our peace-time wants, but this nation's watchword is "Preparedness" and, therefore, our resources for producing this acid are being mobilized to meet any emergency. The output of sulfur has already been increased, new deposits of pyrites are being exploited, new trade routes established, and new acid plants erected. This "Chemical Giant" of our constructive industries must be groomed to defend and preserve these industries should war be thrust upon us.

INDUSTRIAL TRENDS

Competition for Swedish Steel

TROUBLE in Scandinavia has upset other industries than those using wood pulp — paper and rayon producers. Cutting off of Swedish steel from world markets has given the razor blade industry a rude shock. Practically all so-called wafer blades are made of Swedish steel regardless of brand name.

Steel imports for blades run several thousand tons annually, and while this is a small item as steel tonnages run, the product is a premium one. Now, for the first time in history, American steel producers have a chance to capture this market, if they can do it. One concern has been working several years to develop a suitable competitor for the Swedish product and is now in production. Another slowly gets underway.

While almost anything can happen in the European situation, day-to-day news promises no prompt resumption of imports. Couple this with the lack of any substantial inventions in the hands of manufacturers and it spells an eventful dependence upon domestic mills—with quality in the balance.

England and Germany have been large producers and exporters of blades to world markets. Lick the steel problem and much of this business should gravitate to American manufacturers.

Prefabrication Boosts Plywood

WHEN the prefabricated house turns the corner, it will be found that plywood, not steel, is the favored structural material. Plywood has high strength, light weight, insulating properties, and handles with ease. These qualities spell thin walls and partitions, with savings in weight and cost, and ease in shipment. Steel, while providing high strength, has been abandoned by most prefabricators because of weight, lack of insulating properties, and the need for paint protection to prevent corrosion.

Chiefly responsible for the greater interest in plywood is the advent of the phenol formaldehyde resin binder, which holds the laminations of wood together, and makes the product suitable for exterior use. The resin bond is indestructible and is anathema to fungi and termites. Panels so bonded and kept under water for two years show no sign of separation even when the wood itself becomes waterlogged.

The prefabricated house is still coy about making a stage appearance, but the possibilities are much better today than they were four years ago when there was so much chatter about it. Out in front is a concern which offers all-factory made houses in nine standard sizes, but so skilfully designed as to afford a much wider style variety. About 500 were sold and erected last year; this year, with a lower priced model, production may be doubled. Merchandising covers more than a dozen states and the company operates at a profit. This sums up to being a business and not an experiment. It shows what can be done.

Trailing this concern are several smaller ones, but none which meets so completely all the definitions of prefabrication. Some employ partial factory fabrication; others limit their operations to local developments. Most advocates of steel have shifted over to production and sale of framing and panels for industrial rather than housing use.

Prefabrication has had many obstacles to overcome and there are several hurdles yet to take. Early design was unattractive, costs offered very little, if any, advantage over orthodox construction, and strong resistance was met from every element in the building trades from labor on up through supply firms and contractors, to engineers, architects, financiers and public agents, short of the Government. Design is now pleasing, costs favor factory work, but there is still sabotage. This is unlikely to be banished until the force of public demand sweeps it out of existence.

Approach to the problem has also delayed maturation of prefabrication. Most experimenters have been persons seeking new outlets for old materials. Thus, steel producers struggled to get steel houses on the market, while plumbing and electrical supply concerns hastened to find a box suitable to encompass their products. Only by consideration of housing and prefabrication needs first, and then selecting materials to do the job, has the barrier to success been broken.

Proof of this is found in the experience of companies. The top flight prefabricator, for example, spent eight years discarding pre-conceptions. Having tried metals, plywood was adopted, and it is not applied in typical building manner, but skin-stressed a lá airplane. That is, plywood panels are bonded to the frame with resins to make them load-carrying members. Likewise, standard heating equipment was found unsuited and new types developed.

Manufacturers who are actually in production declare that prefabrication has outgrown the "nut and bolt" stage of development, that further preoccupation with technical matters will not accelerate the low-priced housing movement. While much remains to be done, basic problems of construction, they say, have been solved with enough practicability to warrant placing major emphasis upon business building with more attention to consumer taste, merchandising, and wide promotion.

This attitude is reflected in the statement of one producer who says: "The automobile is our chief competitor. When we can offer the consumer as attractive a piece of merchandise with equally definite figures of first cost and upkeep, then we'll begin to have a business. The country isn't breathlessly awaiting the prefabricated house. It must be sold."

If prefabrication continues gains of the past two years what will it mean in material sales? A great expansion in the use of plywood; a scramble to design and place on the market more compact and economical plumbing, heating, air conditioning, and electrical fixtures, in which activity wide awake, small companies can play an important rôle. It will mean also an expanding market for all household effects which go to make up a livable home.

When mass production means thousands instead of hundreds of new homes, it will pay to try to find something superior to plywood for walls. A really low cost plastic is wanted for panels, or, perhaps, something fashioned from farm products or wastes via the chemurgic road.

—Philip H. Smith

Insect Quarantine

Pacific Plane Service Provides Passage for Insect Pests . . . Hawaiian Farms Threatened . . . Midway and Canton Islands Have Pest Control Stations

THE United States may have to face an invasion which all the big guns of our Army and Navy cannot repel. The foe is an army of insects. While transpacific plane service brought this country into rapid communication with the Orient, it also brought a threat of devastation. Plane service, smashing the barriers of time for man, has been quite impartial about man's enemy, the insect.

In the old days, the slower journeys by steamer and sailing vessel were tough on insects with the urge to travel, for the usual insect's life cycle is so brief that few could last out long ocean voyages on ships.

Occasionally, however, insects did manage to survive trips, and the farmers of Hawaii saw and suffered from the destruction caused by the pests. Planters of sugar cane, Hawaii's most important crop, early came to know the need for insect quarantine. They organized and created an experiment station, staffed by agriculturists expert in battling the diseases of sugar cane and insect pests.

Through the knowledge of these entomologists, Hawaii's sugar industry learned how to cope with insect enemies, to liberate in infested fields natural parasites to prey upon the pests, to re-establish nature's balance, and to defeat the invading hordes. But it learned also how difficult it was to bring insect allies from far countries to the Islands — for the time interval for the voyage was as much a bar to parasites as to pests.

WHEN Pan American Airways laid out its route for Clippers to and from the Orient, the scientists of the Hawaiian Sugar Planters' Association urged that quarantine measures be adopted. With the permission and cooperation of PAA officials, a quarantine station was set up on Midway Island. An entomologist was sent to inspect, search, and spray all planes arriving at that island. Experience has proved that the defense was sound.

In the course of a recent 10-month period, 66 planes were searched at Midway. More than 1200 insects were found to have died before arrival. But the search yielded nearly 1100 live ones which were promptly placed in the scientists' poison bottle. It seemed that danger from the Orient was definitely halted.

But the threat has reappeared in another quarter. Pan American has surveyed a route from Auckland, New Zealand, to San Francisco, via New Caledonia, Canton Island, and Honolulu. The first regularly scheduled flight will follow approval of the route by the Aeronautical Commission at Washington and is expected to take off this year. Forewarned by experience on the Orient run, Pan American Airways, together with the Hawaiian Sugar Planters' Association, have already taken steps to set up a second quarantine station on Canton Island for the new route.

The reason for selecting Canton, an uninhabited atoll nine miles long and half as wide, is not apparent at first glance; but it is a sound choice. Canton is the intermediate landing point for Clippers flying between New Caledonia, a potential plague spot of the South Pacific, and Honolulu, with its 154,476 population. Canton, however, has no human population, little vegetation, and few insects. Hence, it becomes an ideal spot for a protective quarantine control. By the time the Pan American Clippers are ready to begin their flights, the HSPA bug man, already appointed, will be on hand with his sprays, and any insect stowaways heading for Honolulu will be summarily executed at Canton.

The same speed which enables insect pests to survive long trips in planes, permits importation of insect parasites (in special cages, as shown above) to fight them

Sandia Man

Artifacts Found in Basal Layers of a Cave in New Mexico Give Evidence of Earliest Known Man in America . . . But Just Who Was That Man?

By FRANK C. HIBBEN
Museum of Anthropology, The University of New Mexico, Albuquerque

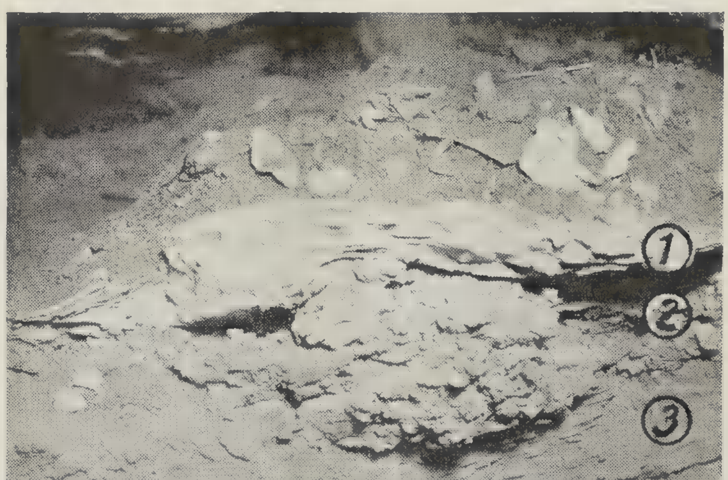
THE archeological bird, which always flies backward because it doesn't care where it is going but wants to see where it has been, is again on the wing. A recent discovery in a New Mexico cave has pushed back the history of the first Americans still further into a shadowy past.

Both North and South America have long been forced to take seats in the background whenever the question of the antiquity of man has arisen. Our predecessors of Europe who killed the mastodon and grappled with the cave bear are well known, and every grammar school child is familiar with their appearance and their tools. The New World, however, has not been able to boast of 50,000- or 100,000-year-old ancestors with hairy skins and protruding jaws. Instead, we on this side of the Atlantic have to be content with a moderate background of antiquity and with human beginnings derived second hand from the Old World by means of migrations across the Bering Straits.

It is for this reason that the discovery of a cave habitat of ancient hunters in New Mexico has been followed with much interest by anthropologists. These early Americans give promise of being the earliest inhabitants yet discovered in North or South America and comparable in age with some of the European oldsters.

In the Sandia Mountains, near Albuquerque, New Mexico, three years ago some archeologists were crawling through a limestone cave of unusual length. In the dust and debris of the cave floor one of them scuffed up a bit of bone — a piece long and curved and sharp on one end. This was the claw of a giant sloth which had ambled over these limestone hills some 10,000 to 20,000 years ago. Since this initial discovery, the Sandia Cave has been the scene of much activity. Flickering torches and acetylene lanterns have sent shadows dancing in gloomy corridors where the sloth laired in by-gone ages. The chambers and passages of the cave have reverberated with the clang of the sledge and pick and the rattle of wheel barrows.

Gradually there has come to light a human story which could be pieced together from evidence gathered during the last three years in this cavern home. Here there was a fire hearth with the blackened fragments of a camel jaw beside it, though many thousands of years have elapsed since the camel, which originally evolved in the New World, was native to the Southwest. Dart points were scattered among the broken bones of the animals which had been killed, perhaps, with these same points. Scrapers and knives of flint and bone splinters broken for the marrow gave evidence of Sandia hunters and their domestic life. A cave man of ancient America gradually took form.



A vertical section of the deposits in the Sandia Cave. Numbered layers indicate: *1*, the crust that sealed in the deposits below. *2*, Folsom breccia. *3*, yellow ochre. *4*, the Sandia layer (note point found in place)

This, in itself, is not remarkable, for evidences of a very early type of American who had hunted now extinct mammals and who lived during the rainy period just after the last glaciation have been found before. Of these, one of the most famous is the so-called Folsom Man, named from the little town of Folsom, New Mexico. Folsom Man was a hunter who ranged up and down the foothills of the Rocky Mountains hunting a peculiar type of bison or buffalo now long extinct. This type of man left traces of his passing in a distinctive type of javelin point which looks like a short bayonet with a groove running up either side. These Folsom points have been found from Saskatchewan to Texas and for the last decade have been considered as indicating the earliest known human evidence in the New World.

AT first it was thought that the Sandia evidence was only another phase of the Folsom, a variation perhaps, or another tribe. Results of the latest digging has, however, given conclusive evidence of a group of men who hunted the green hills of New Mexico long before even Folsom Man. These were contemporaries of the mammoth and the mastodon, and of the American horse and the camel and the savage predators who preyed upon them. Evidence of these earlier animals is not founded on guesswork or even on clues, but is based on the science of stratigraphy. Stratigraphic evidence is derived from the long-known fact that he who is first gets in on the ground floor. Thus, if we dug in New York, we would find the relics of the Gay Nineties buried in the city dump below the more modern remains of our own era. We would correctly conclude that the battered remains of the horse car represented an earlier vehicle than the automobile which lay above it. The joker in the stratigraphy is, of course, in the difficulty of finding remains which overlie one another. If, instead, the deposits are side by side, no matter how primitive or advanced one

or the other might be, it is difficult to establish the precedence of one over the other conclusively.

The Sandia Cave, happily, is well stratified. On the top surface throughout the cave is a heavy deposit of dust, bat guano, and broken fragments fallen from the roof. Mingled with this dust at the front of the cave are fragments of pottery, baskets, and yucca sandals of the Pueblo era. Below the uppermost layer of dust is a crust of stalagmitic material some three to six inches thick (marked *1* in the photograph). This records a period when the cave was wet and when water containing calcium carbonate in solution dripped from the ceiling and spread out over the cave floor in a sheet which was deposited as the water evaporated. Under ordinary conditions only a fraction of an inch of this material is formed in a century. More important than its possibilities of indicating age in the cave, it was effective in sealing in the deposits below it, and thus prevented any mixture of recent material with the ancient which lies beneath. Thus the remains of extinct mammals and the cultures which accompany them have been completely enclosed and unaffected by disturbing influences until the sledge and the pick of the archeologists broke through.

THE geological epoch just prior to our own is called the Pleistocene. This time was characterized by the formation of great sheets of ice in Continental glacier form in both North America and Europe. The fauna of the Pleistocene is extremely distinctive, insomuch as most of the species then extant are now extinct. Wet periods accompanying these glacial times made great changes in areas now dry. The mammoth grazed amidst plenty on slopes which are now barren and rocky. The stalagmitic crust in the Sandia Cave is evidence of one of these wet periods when the hill above the cave was deluged with rains and snows now unknown there. All material below this crust is Pleistocene in date. No mammal bone or fragment of Pueblo culture occurs below this level.

Immediately beneath the calcium carbonate capping of the cave lies a thick layer — the one marked *2* — of debris, dirt, and bone fragments consolidated into a homogeneous mass by the same material as the capping above. This consolidated material is a great flat hasty pudding in which are mixed ingredients which were lying around on the cave floor in the late Pleistocene. There are fragments of bone and teeth representing the garbage piles of beasts and men. Pieces of rock of all sizes are covered with dust blown or carried in from the cave entrance. Chips of flint, scrapers, and points are consolidated in this material as though liquid cement had been poured over the whole to make sure none moved from the positions they had assumed during the Pleistocene. Most interesting is the fact that the projectile points in this material are true Folsom type. Evidently the Folsom bison hunters occasionally used the cave when on trips in the vicinity, and lost or left them there.

Above: Stone scrapers and gravers of Sandia man, also javelin points. *At left:* A Folsom point, the darker object, not the brighter one, found embedded in a matrix near a bone of a camel—proving their contemporaneity

Beneath the Folsom layer lies a thick deposit (marked *3*) of yellow ochre stratified in laminae and evidently water-laid. This, then, represents a second or earlier wet period in the cave's history. At this time the drip and trickle of the cave waters were not disturbed by any inhabitants or visitors. The sloth shunned the mud and slime of the cave floor, and so did man as well, for there is no indication in the ochre layer of any disturbance or any casually dropped implement or bone.

Below the ochre and between it and the solid limestone of the cave floor are the most important deposits of the cavern (marked *4*). These were accumulated during a dry period, the first in the varied history of this abode. In these lowest levels there was again evidence of grisly meals, bone fragments, fires, and flint implements. These latter are javelin points entirely different from the later Folsom variety. They are notched from one side, forming a single shoulder in a manner very similar to flint points of the Paleolithic or Old Stone Age of Europe. That the Sandia points may be comparable with some of the earliest implements of Europe is a distinct possibility.

European remains of the Paleolithic variety were made mainly by types of men having certain primitive characteristics. They walked with a stoop-shouldered, bent-kneed gait. Their heads were fastened on their necks far forward, like those of a gorilla, and their jowls protruded while their foreheads receded. Such a type of man as these has been eagerly sought for in the New World since scientific endeavor in Europe began. So far, there has been no success. First, Folsom Man and now Sandia Man, seemed to give promise of being this American link. The probable truth is that even such an oldster of the last of the ice age as Sandia Man would look no worse if we saw him on the street than some of the least attractive of our politicians. Yet, in order to satisfy a perfectly natural as well as scientific curiosity, we would like a look at Sandia Man's bones — if only he has left one of his dead in a corner of the cave, and if the rats have spared him sufficiently so that we can see his outline. Such a discovery would solve one of the most pressing of the queries concerning the mystery of the first Americans. That Sandia Man lived, loved, hunted, and died in the time of the mammoth and the sloth we now know. Perhaps the as yet unexcavated portions of the cave will answer the questions of his appearance.

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Readers will note that, in the case just described, the evidence calling for Pleistocene antiquity is based on stratigraphic grounds. In all too many of the instances where claims of high antiquity were made these were based on finding human artifacts associated with bones of animals that lived in Pleistocene times — and nobody yet knows how much longer toward or even into our own era.—The Editor.

Is Atomic Energy Nearer?

Physicists Talk Down Some Fabulous Claims . . . But New Findings May Alter the Picture . . . Prediction Probably Unsafe . . Immediate Development Unlikely

By ROY H. COPPERUD
University of Minnesota

EYES of the scientific world — and of a good part of the lay population, too — widened the first week in May at the startling news that work of a 28-year-old physicist at the University of Minnesota in isolating the explosive uranium isotope, U-235, had been corroborated, marking a significant advance toward shackling atomic energy.

The physicist is Dr. Alfred O. C. Nier, who modestly expressed dismay at extravagant reports which blossomed on front pages everywhere, to the effect that the incalculable forces of the atom were on the verge of being pressed into the service of mankind.

There were fabulous predictions that this discovery made feasible bombs of unheard-of strength, that five or ten pounds of U-235 would propel a vessel around the world for an indefinite time without refueling — in short, that economic foundations of the world were about to crumble.

The fact of the matter, he insists, is that many a knotty problem remains to be solved before any useful harnessing can take place. Chief among these is extraction of U-235 in vastly greater quantities than is possible now.

Yet authorities in the field concede that the discovery is a stride of unprecedented importance toward opening up a new and virtually limitless source of power. Dr. Nier himself admits that large-scale extraction "is surely within the range of possibility."

It was the work of Dr. John R. Dunning at Columbia University in New York, aided by Dr. E. T. Booth and Dr. Aristid V. Grosse, that clinched the findings of Dr. Nier. The New York physicists, subjecting Dr. Nier's infinitesimal samples of U-235 to a slow neutron bombardment, confirmed successful isolation of the isotope, and demonstrated its explosive properties.

For about a year previous to last February, when Dr. Nier first accomplished the separation, it was known that uranium would blow up if bombarded with slow neutrons, releasing immense energy. Discovery of this fact was made by two Germans, Dr. Otto Hahn and Dr. Lise Meitner, in Berlin.

The explosions, however, were incomplete, and the results baffling. Baffling, that is, until a theory was advanced by Prof. Niels Bohr, Nobel prize winner at the University of Copenhagen, and Dr. John A. Wheeler of Princeton University, that U-235, one of the three isotopes which constitute uranium, was responsible.

This was only a hypothesis, albeit a good one, until Dr. Nier blazed the trail in separating U-235 from its brother isotopes, U-234 and U-238. Sieving them out in a mass spectrometer, he obtained quantities sufficient for testing. These were sent on platinum collecting plates to Columbia.

WHAT happens in the bombardment is that slow neutrons crack U-235 atoms as a baseball bat would crack a walnut, splitting them in two. Accompanying the explosion is a terrific release of energy. Particularly significant is the fact that, in a quantity of U-235, the process is cumulative, for the smash sets free other neutrons, which in turn attack other atoms. Once begun, the process will continue automatically — a "chain reaction."

When natural uranium was first bombarded, the explosions did not continue in this fashion because of the great preponderance of U-238. The stray neutrons which would keep the action going in pure U-235 collided with atoms of U-238, which are unaffected by the slow barrage that shatters U-235. Consequently, there was an effect of smothering. Even with pure U-235, a considerable amount would be required, for many of the neutrons fly off harmlessly into the air.

Dr. Nier estimates that one pound of U-235 would generate as much force as the combustion of 2,000,000 pounds of coal, or that its detonating energy would be equivalent to that of 20,000,000 pounds of high explosives.

All of which sounds vastly encouraging [and just at present in some aspects a bit alarming.—Ed.]—except that the greatest amount of the isotope that he has yet been able to produce is less than a microscopic 1/100,000,000 of an ounce.

It was formerly believed that U-235 made up only one part in 1000 of natural uranium. The occurrence of the explosive isotope is actually far more frequent than that, however, for Dr. Nier's instruments showed a proportion of one U-235 atom to every 139 of U-238, another of the trio. Thus natural uranium contains seven times more of U-235 than had been supposed.

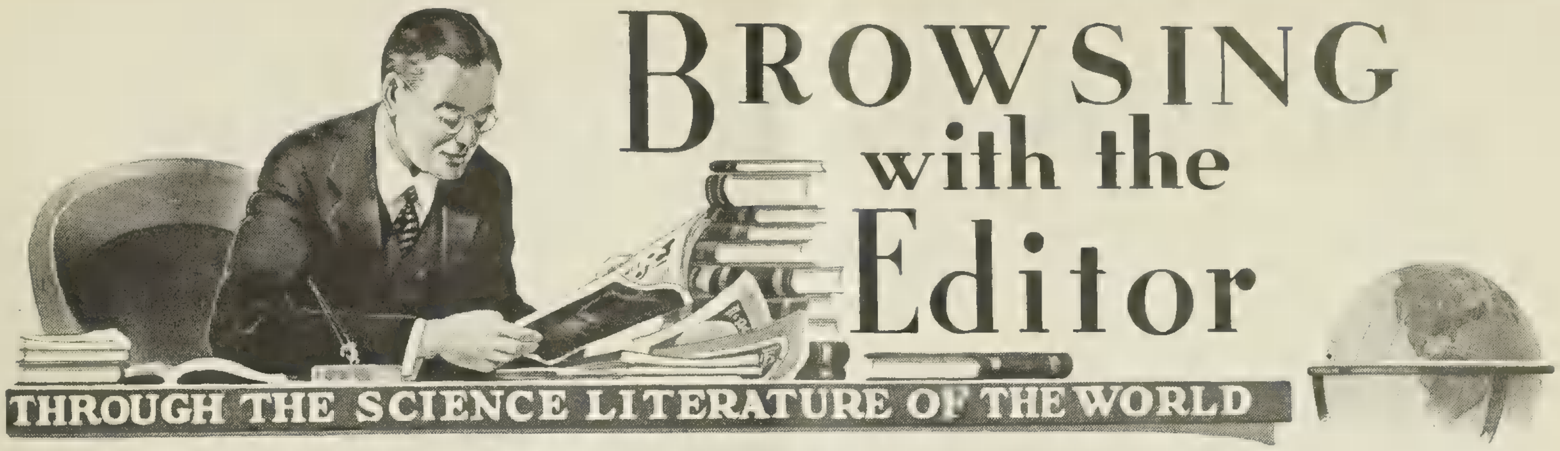
Dr. Nier's separation work was duplicated by Dr. K. H. Kingdon and Dr. H. C. Pollock of the General Electric Company's laboratories, and their samples produced the same result in the Columbia cyclotron as those isolated at the University of Minnesota.

Rumors said that the discovery had set all available researchers in Germany at work in the Kaiser Wilhelm Institute at Berlin to seek a means of economically extracting U-235 in commercially usable amounts. Large deposits of uranium are found in Germany, also in Canada, the Belgian Congo, England, and Colorado.

Dr. Nier estimates that, even with any reasonably economical means of extracting U-235 in large quantities, the cost per unit of energy produced would equal that of coal. "So you see," he observed, "it would not mean getting power for nothing." Despite the extraction cost, the great amount of energy concentrated in a small volume would make it invaluable for airplanes, for example, or any other apparatus where weight of fuel is a consideration.

The Minnesota scientist considers it hardly likely that the mass spectrometer, the device he used to separate the uranium isotopes, can be adapted to mass production. It is more probable that some chemical means of separation would turn the trick. But as to any such method, researchers are still at sea. Dr. Nier emphasized further that, once extraction is accomplished, the problems of handling and chaining the atomic force safely might occupy scientists for years.

This is the abbreviated story of what may well prove to be one of the great crests of scientific achievement. True, researchers are cautious about advancing ambitious claims, and Dr. Nier himself believes that remaining obstacles to chaining atomic power will persist far into the misty future. But only ten years ago it was considered impossible to separate the isotopes of any element whatever, and now it is being done commercially with hydrogen.



SYPHILIS IN U. S.—The annual attack rate of syphilis per 100,000 people in the United States in 1935 was 796, compared with 47 in Great Britain (clinics only), 20 in Denmark, and seven in Sweden. —*The Journal of the American Medical Association, 114,* 1321 (April 6, 1940).

SA

CELESTIAL MECHANICS.—The mathematical theories of the celestial motions are of a complexity almost beyond conception, and the length of some of the calculations involved is appalling. Single formulas that fill dozens of printed quarto pages, series expansions in which hundreds of terms must be used, and single calculations that require years to accomplish, are not unusual in celestial mechanics.—Edgar W. Woolard, *National Mathematics Magazine.* (January 1940).

SA

DON'T BLAME THE RAZOR.—The average man, "cussin'" his razor blade roundly, doesn't realize that each hair's-breadth of blade edge has to cut 100 hairs in a once-over shave; or 200, twice-over.—E. J. Casselman, Mellon Institute of Industrial Research.

SA

OIL PAYS.—Nearly one twelfth of all the carload freight revenue of American railroads in 1939 was paid for the transportation of petroleum products.—Interstate Commerce Commission.

SA

AUTOMOTIVE COSTS.—The typical wage-earning, car-owning family spends $197.74 annually to operate its car for business and pleasure.—U. S. Bureau of Labor Statistics.

SA

INSULATION SAVES.—United States Government tests on identical houses, one insulated and one not insulated, showed a fuel cost for the insulated house 44.75 percent lower than that for the non-insulated.—National Warm Air Heating and Air Conditioning Association, 11 West 42nd Street, New York.

SA

WAR AND PAPER.—American paper makers regularly import from Scandinavian countries more than one fifth of the pulp they need, with Sweden leading among suppliers.—*Science Service,* (April 11, 1940).

SA

LONG RAYS WEAK.—Suggestions that long, invisible infra-red radiation could be used to pierce fog have been refuted by experiments.—J. A. Sanderson, U. S. Naval Research Laboratory, Washington, D. C.

SA

INSECT ENEMIES.—Throughout the world, there exist nearly 500 plants that are carnivores, or insect eaters.—Brooklyn Botanical Garden, Brooklyn, New York.

SA

"HYPODERMIC."—Oil squirted at high pressure from tiny holes, such as those in Diesel injectors, often penetrates the flesh of workers. Though the oil penetrates to a considerable depth, the worker is not immediately aware of his injury.—Dr. G. Failla, Memorial Hospital, New York.

BETTER SHOOTING.—During the recent war between Finland and Russia, the average number of shots fired for each airplane destroyed was 54, contrasted to 11,000 shells needed to bring down each airplane at the beginning of the World War and 6000 shells at the end of that War.—*The Illustrated London News,* (April 13, 1940).

SA

SPARKLESS.—To prevent generation of static sparks by belting, one powder manufacturing company keeps belts in a moist condition by frequent applications of 50 percent glycerol and 50 percent water.—*News Edition,* American Chemical Society, *18,* 355 (April 25, 1940).

SA

PETROLEUM RESEARCH.—The growth of research in the petroleum industry has been more rapid than in most industries, having expanded 639 percent in 11 years and having risen from seventh largest to second largest. For every 10,000 wage earners in the petroleum refining industry there are 563 research workers—almost twice as many as in the chemical industry which is reported to have the next highest concentration.—*News Edition,* American Chemical Society, *18,* 347, (April 25, 1940).

SA

PROVED SUPERIORITY.—The aluminum mirror coating of the 100-inch telescope at the Mount Wilson Observatory lasted five years and was recently renewed. Silver coatings, formerly used on telescope mirrors, lasted only a few months.—*Publications of the Astronomical Society of the Pacific, 52,* 145, (April 1940).

SA

OIL UNLIMITED.—It seems altogether likely that nature is continually producing more oil underground, perhaps at a faster rate than gas pressure or pump stroke can bring it to the earth's surface. —Dr. Gustav Egloff, Universal Oil Products Company, Chicago, Illinois.

SA

CHINCHILLA FUR.—Eleven chinchillas were brought from South America 17 years ago. Though difficult to breed in the United States, the original group has grown to 3500, 2000 of which are located in the home chinchilla ranch in California, while the remainder are scattered throughout the country.—Trane Company, La Crosse, Wisconsin.

SA

FAT PEOPLE.—The old belief that women can withstand cold better than men has been proved correct by calorimetric measurements made on nude men and women at the Cornell University Medical College. It was shown that, if men were by nature provided with a layer of fat tissue about one sixth of an inch thick, they would be on a par with women in heat retention.—National Academy of Sciences, *Abstracts,* Annual Meeting, 1940.

SA

HEAT DEATHS.—In 1939 more persons died from heat stroke indoors than out. The exact percentages were 67.1 percent in the home; 22 percent in factories; and 10.9 percent in public places. The reason is simple. Both the very young and the very old—most susceptible to heat—spend more of their time indoors than do others.—National Warm Air Heating and Air Conditioning Association, 11 West 42nd Street, New York.

Bleak Black Ball Of Rock

After Ten Years the Planet Pluto's Mass Has Been Determined . . . Denser, Darker, More Massive than Was Expected . . . Laborious Computations

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

A PROBLEM which looked as if it might remain unsolved for many years has been cleared up recently by Professor Brouwer of Yale—who reported his results at the last meeting of the Astronomical Society. Ever since Pluto was discovered, attempts have been made to find its mass—and previously with no success.

The problem is simple enough in principle, though very complicated and laborious in detail. The attraction of Pluto upon the other planets modifies, or "perturbs" their orbits, by an amount proportional to the attracting force, and hence to the mass of Pluto itself—which can be found, if we can determine from observation the actual magnitude of these perturbations. Given precise information about the orbits of Pluto and any other planet—say Neptune—the calculation of the perturbations can be made by standard methods—none of them simple, because the problem is inherently complicated mathematically. There are two main lines of attack—the "general" method, which derives formulas from which the perturbations can be calculated at any time, and the "special" which determines their effects only for a given interval of time.

The first is enormously laborious, especially when, as in the present case, the orbits are eccentric, inclined, and come relatively near one another. When the results have been obtained, they are applicable almost indefinitely. Hence these methods alone are of value for the Moon, the satellites of Jupiter, and the inner planets, which have already been observed over hundreds or thousands of revolutions.

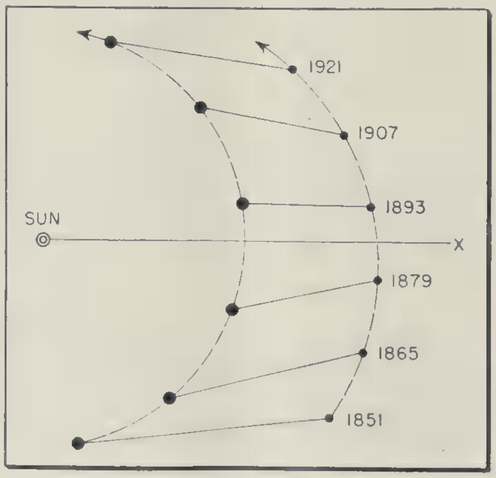
The second method calculates step by step, giving accurate values over the interval of time covered by the computations, but tells us nothing about the future until the calculations have been extended to cover it. For two or three revolutions, or less, this second process costs less work than the first.

The two methods follow entirely different mathematical paths—diverging at the start and meeting only at the finish —so that, when both have been applied to the same case, they afford a very complete check upon one another.

The perturbations of Neptune, for example (except those due to the undiscovered Pluto) were calculated by Newcomb 40 years ago. A recalculation by the second method has just been made by Brouwer, using modern "punched-card" calculating machines, which save a great deal of time and money. The results of the two methods agree excellently, over 160 years, except for a regularly recurring deviation in longitude, of maximum amount 0".15 with a period of 12.8 years, exactly that in which Jupiter catches up with Neptune. A term of this period appears in Newcomb's tables, and it is clear that, despite the great care taken by this distinguished investigator and his assistants, some numerical error must have crept into its coefficient. Recalculations are being made by the first method.

THE perturbations due to Pluto can be calculated, just as well as for any other planet, but when the attempt is made to use them to find Pluto's mass, a new complication arises.

We must find, from the observations of Neptune, not only these perburbations, but the size and shape of its orbit. If Neptune had been observed all around its orbit for several revolutions, like Jupiter and Saturn, we could determine the orbit almost independently of the perturbations, since these would be different in successive revolutions, and almost average out. But Neptune was discovered in 1846, and has been only a little more than half-way round the Sun since then. Consequently, when its motion is perturbed by Pluto, it is possible to find another orbit, such that a planet moving in it, and not subject to Pluto's attraction, would simulate very closely the motion of Neptune in its real orbit, disturbed by Pluto. The motions of the real and fictitious planets would diverge in the unobserved parts of the orbit—but this leaves us no wiser, though our grandchildren will be. The existing orbits of Neptune, calculated, without taking account of Pluto, so as to fit the observations as closely as possible, are of this "fictitious" type, and it is only from the differences between the observed positions of the planet and those calculated from these adjusted orbits that we can find out how much influence Pluto really exerts.



Positions of Neptune and Pluto, projected on plane of Neptune's orbit

This matter was thoroughly discussed, a few years ago, by the late E. W. Brown. He concluded that it was not at present possible to obtain a reliable determination of Pluto's mass, either from observations of Neptune, for the reasons aforesaid, or of Uranus, which is too far from Pluto.

Brown, however, considered only the longitudes of the planets. The latitudes —measured, if we will, from the mean orbit plane—usually suffer much smaller perturbations—since all the planets move in nearly the same plane. But Pluto's orbit has the high inclination of 17 degrees to the ecliptic, or 15½ degrees to Neptune's orbit, and this puts it far out of the general plane of the system.

The situation is illustrated in the sketches. The first represents the positions of Neptune and Pluto during the interval of observation as projected on the plane of Neptune's orbit. The planets were in conjunction in 1892, at a distance of 19 astronomical units, and have been closer together than the average over the whole time.

The second sketch represents the planets as seen from afar perpendicular to the plane of Neptune's orbit, along the line *Sun-X* in the first. From this point Neptune would appear to oscillate back and forth in a straight line passing through the Sun, while Pluto, during the interval of observation, was continuously on the south side of the orbit plane.

The attraction of Pluto on Neptune throughout this interval tended to pull Neptune away from the Sun, as is evident from the first sketch, but, as has been explained, the principal influence of this will be to alter the calculated elements of Neptune's orbit. But the component of attraction at right angles to the plane of Neptune's orbit tends to pull it out of the plane. No adjustment of the assumed orbital elements can do much to help this, for, in the absence of perturbations, the orbit must be exactly plane. (The actions of the other planets can be accurately computed and allowed for—after which they may be ignored, and only Pluto considered.)

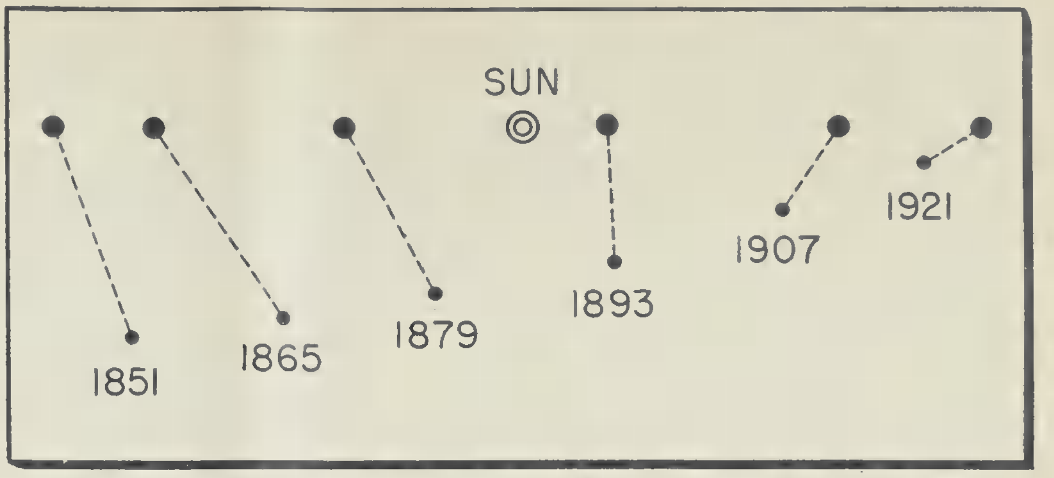
After making the best adjustment of the calculated plane that we can, we may expect to find Pluto south of this plane at the beginning of the observations, north of it in the middle, and south again at the end. This is exactly what Dr. Brouwer has found, after making just such calculations. In 1850, Neptune was 0″.5 south of the calculated position, in 1900, 0″.2 north of it, and, in 1936, 0″.4 south. Though there are some fluctuating errors in the observations—as is inevitable—the general trend is unquestionable.

MEASURABLE effects of the attraction of Pluto on Neptune have thus been found. From these Brouwer finds that the mass of Pluto is 1/400,000 that of the Sun, or 83 percent of the Earth's, with a probable error of eight percent.

The perturbations in longitude, between 1846 and 1936, are almost completely obscured by the adjustment of the orbit. But two earlier observations of Neptune exist: Lalande, in 1795, while cataloguing faint stars, made two observations of the planet supposing it to be a star. These agree well with one another, and give a residual deviation of 10″ in longitude from the orbit adjusted without regard to Pluto. If perturbations by Pluto, with the mass determined from the latitudes, are taken into account this discordance disappears. By itself, this deserves no great weight, as Lalande's observations were not of high accuracy; but the agreement of the two determinations is satisfactory.

Dr. Brouwer is investigating Uranus by similar methods. Here the attraction of the Sun is greater, and that of Pluto less; but it will be of much interest to learn what can be derived, especially from the latitudes, but it is improbable that the results will compare in accuracy with those already derived from Neptune.

The mass of Pluto thus takes its place in the list of known data for the solar system. It is surprisingly great—equal, within the limits of error, to that of Venus, which is 1/410,000 of the Sun's. It is not the actual value which is surprising—we have no excuse for any



Neptune and Pluto, projected on a plane perpendicular to Neptune's orbit

anticipations on the mere knowledge that a trans-Neptunian planet exists. But the faintness of Pluto suggests a much smaller value.

If Venus could be put at Pluto's average distance from the Sun and Earth at opposition, a simple calculation shows that it would appear as a star of visual magnitude 11.8. The measured value for Pluto, reduced to the same standard conditions, is 14.7. Hence Pluto reflects only seven percent as much light as Venus would if put in his place. If of the same size as Venus, his reflecting power, or albedo, must be correspondingly small. Now the albedo of Venus has the high value 0.59, but, even so, that of Pluto comes out only 0.04. This is so very low that the planet's surface would be called dark gray, or almost black (not brown, for Baade's observations show that, unlike the Moon, the light which it reflects is of the same color as direct sunlight).

The Moon itself reflects seven percent of the incident light. If it were not for the weakening of the light of the half-moon by the shadows of the innumerable roughnesses on its surface, this value (which represents the average for light reflected in all directions) would be raised to 10 or 12 percent. We see Pluto at the full phase: hence it may be concluded that, if it is of the same size as Venus, the average reflecting power of its surface is probably between 30 and 40 percent of the average for the Moon.

This is clearly not impossible, for the darkest spots on the Moon are made darker than the average; but it is about at the limit of plausibility.

We cannot well escape the difficulty by assuming that Pluto is smaller than Venus, though of the same mass, for this would make it denser, and Venus, with a mean density 4.9 times that of water, is denser than any other planet except the Earth.

TO assume that Pluto was twice as dense as Venus would be going wild —making its mean density greater than that of the core of the Earth, composed of metal under enormous pressure. But even this would raise the calculated albedo only to 0.06.

There seems to be no escape, therefore, from the conclusion that the surface of Pluto is almost black. This is the more remarkable because Pluto, like Venus or the Earth, ought to be able to retain an extensive atmosphere. It is reasonable to suppose that, like these planets, Pluto lost any hydrogen which its atmosphere contained early in its career. But an atmosphere which contained water-vapor like the Earth's, or carbon dioxide like that of Venus, would, at the very low temperature of Pluto, send these substances down in permanent snow. Nitrogen and the inert gases would remain to form a permanent atmosphere, even at this temperature; but, if this atmosphere were of any considerable extent, it would scatter enough light on its own account—like the sky—to make Pluto look much brighter and bluer than it is. It appears, then, that Pluto is an atmosphereless ball of black rock.

All this depends on Brouwer's determination of the mass; but the evidence for this is so strong that it altogether outweighs considerations based upon the supposed improbability of conditions which certainly do not appear to be physically impossible.

Neptune's satellite, sometimes called Triton, is of very nearly the same brightness as Pluto—or, at least, it would be if the two bodies could be observed at the same distance, which will happen about 1989, when Pluto is in perihelion. The satellite's mass has been determined by Nicholson, van Maanen and Willis by observing the small oscillation of Neptune's position about the center of gravity of the system as the satellite describes its orbit. They find a value about one twelfth of the Earth's mass, or one tenth of Pluto's. Allowing for a slightly lower density, we may estimate that Triton has about half the diameter of Pluto, and four times its albedo. The difference between the two bodies is surprising, and illustrates the danger of guessing at the mass of a planet or satellite from its brightness. — *Princeton, May 4, 1940.*

SEEING WITH ELECTRICITY

New Electron Microscopes Now Being Developed Far Outdo High-Powered Optical Microscopes . . . Reveal a World Hitherto Unseen by Man

By JEAN HARRINGTON

IN this age of super-movies, super-telescopes, super-cyclotrons, and super-whatnots, we are apt to pass over lightly the news that a super-microscope has just been built. But such news has just popped out of New Jersey, following within a year two similar announcements from Canada and Germany; and to anyone interested in the progress of science, it sounds a good deal more important than the latest super-movie.

The electron microscope already has become a powerful and a practical instrument. With it, science can explore

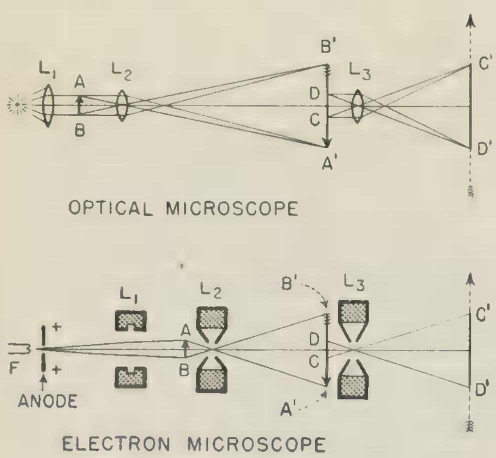


Figure 1: **A comparison of the optical and electron microscopes. The one does its ray bending with glass, the other with magnetism from the coils L_1, L_2, L_3, explained in text**

a new world of things infinitely small—disease viruses, for example, which have never before been seen or photographed—and this may lead to important medical discoveries.

We are all of us familiar with the ordinary optical microscope. Perhaps we have used it in the laboratory to see the teeming life in a drop of pond water, or to study the fragile nerve endings in the tissue of a frog's leg. The upper part of Figure 1 shows how such a microscope works. The object or specimen—suppose it is our drop of pond water—is represented by the short arrow *AB*. It is brightly illuminated; light from the lamp is concentrated on it by the lens L_1. The lens L_2 bends the light from the object and focuses it to produce an enlarged, inverted image of the water drop at *A'B'*. Then the lens L_3 takes light from any part (such as the section *CD*) of the first image—a single amoeba, perhaps, swimming sluggishly in the drop—and re-focuses it to give us a still more enlarged image at *C'D'*. This is what we see if we peer through the eyepiece of the microscope, or what we can photograph if we care to put a film there.

The electron microscope shown in the lower part of the same figure is arranged and behaves quite similarly. It has illumination, three lenses, and two magnified images in cascade. But, instead of light for illumination, it uses streams of electrons from the hot filament or cathode at *F*; and in place of glass lenses, three magnetic coils, by curving the electron paths, do the focusing. A more detailed discussion of the instrument will be found later in the article.

The analogy between the two microscopes follows the close analogy between light and electricity. Visible light, we know, is a wave motion, one of a large family of electro-magnetic vibrations ranging from radio waves to the gamma rays from radioactive materials. Figure 2 shows where visible light ranks in this family. From the broadcast and short-wave radio bands, down through the infra-red or heat rays, from the red to the violet of our sunlight spectrum, down through the ultra-violet and the X-rays, the wavelength steadily decreases; when we come to gamma rays, we have waves less than a billionth of a centimeter long. For convenience, these short wavelengths are measured in angstrom units, an angstrom being a hundred-millionth of a centimeter, or 1/250,000,000 of an inch. The visible spectrum ranges approximately from 3900 to 7600 angstroms.

WE usually think of an electric current as a stream of electrified particles rather than as a train of vibrations or waves. The electrons flowing in our telephone and lighting circuits we picture as tiny bundles of negative charge. Yet the curious thing about them is that under certain circumstances they behave as if they were waves instead of particles. In 1924, De Broglie showed that, in theory at least, a moving electron should have a definite wavelength associated with it, and his theory was proved true by experiment some three years later. It was shown that electrons, like light, can be reflected or refracted at surfaces, and are subject to familiar interference and diffraction phenomena in which different electron streams add or subtract to form patterns of light and shade. (Parenthetically, just as electrons act sometimes like waves, light waves on occasion behave like particles—a beautiful if somewhat confusing example of the harmony and inter-relationships of nature.)

The De Broglie wavelength of a moving electron depends only upon its velocity, decreasing as the speed increases. A "one-volt" electron—that is, an electron accelerated by a potential difference of one volt—travels at nearly 370 miles per second, and has a wavelength of about 12 angstroms. A "million-volt electron," whizzing along at more than 175,000 miles per second, has a wavelength of about a hundredth of an angstrom. How this range compares with that of light is shown in Figure 2.

This comparison leads to the essential advantage of the electron microscope over the optical variety. The ability of any kind of microscope to show clearly minute objects is sharply limited by the wavelength of the illumination it uses. It has been found in practice that this limit is approximately half the value of that wavelength. In other words, you can't distinguish objects or details of objects the dimensions of which are less than half of the particular wavelength

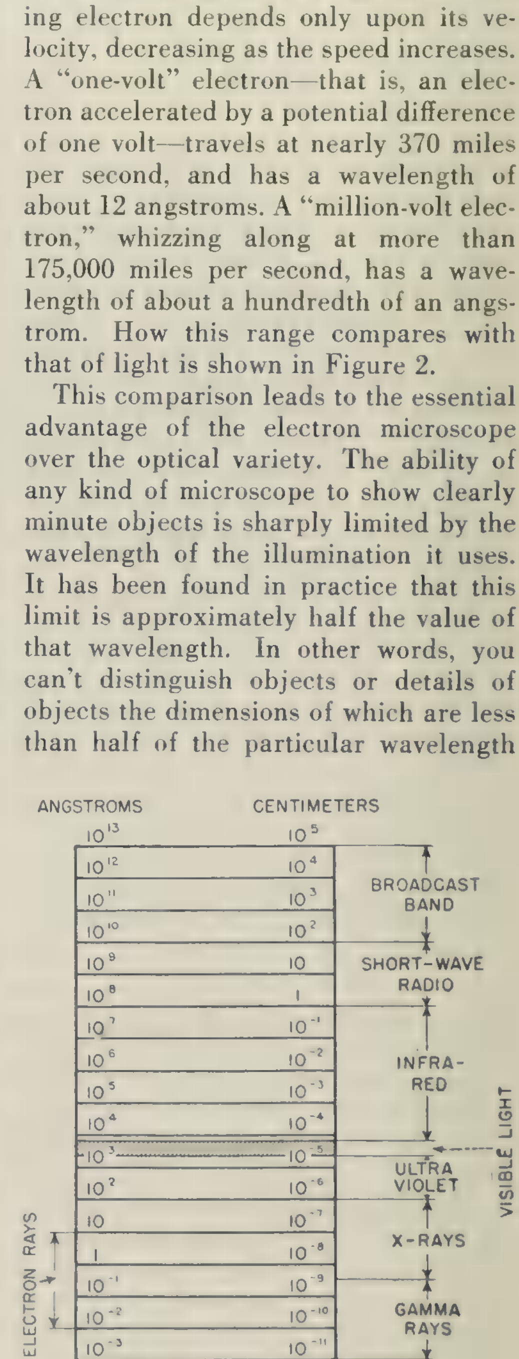
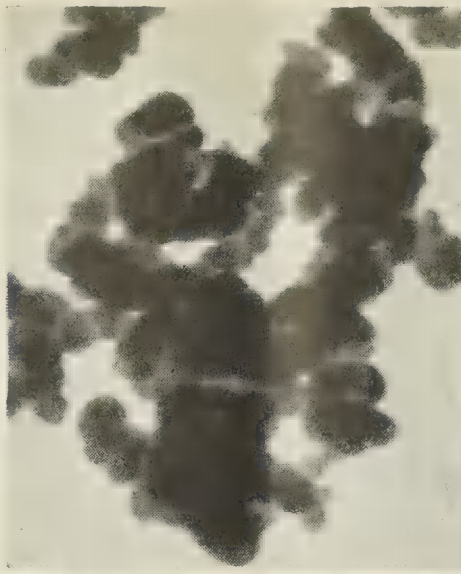


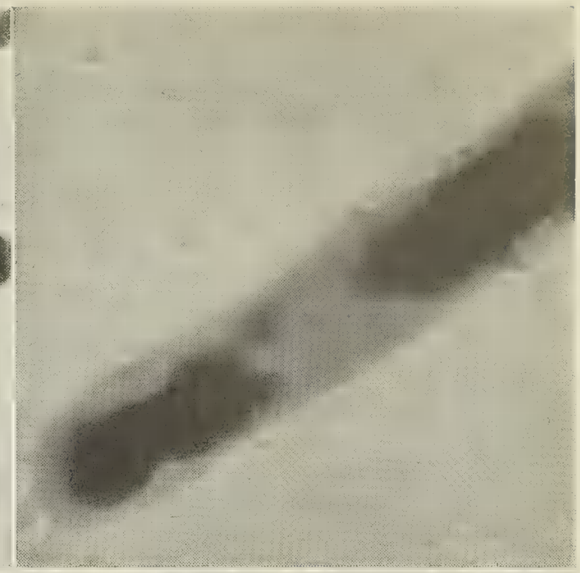
Figure 2: **Comparison of wavelengths of the family of electromagnetic waves and of electron rays**

you choose for illumination. Obviously, then, the shorter the wavelength, the smaller the details you can observe.

The reason for this is to be found in the phenomenon of diffraction. Without going into a full explanation, which belongs in a book on optics*, suffice it to say that diffraction is a special case of interference of waves, and is caused by wave trains bending around corners or the edges of opaque objects. Although the phenomenon is universal, we don't ordinarily notice it, for the effects are negligible when the object is large and the wavelength small. But in microscope work, where specimens and wavelengths are the same order of magnitude, diffraction rears an ugly head. There its effect is one of diffusion and blurring. A sharp line in the specimen appears in the image as a broad one, flanked on either side by bands of dark and light. A point reproduces in the image as a disk surrounded by dark and light concentric circles. These are known as "diffraction patterns."

When you see a circular diffraction pattern in a microscope, you know a particle is present; but different sized particles may have identical patterns, and you can deduce nothing about the actual magnitude and shape of the particles. Or, if two particles in the specimen are less than a half wavelength apart, their diffraction patterns overlap in the image and you cannot distinguish them as two separate points. The size of the diffraction pattern does, however, decrease as the wavelength decreases; so it happens that, with short-wave illumination, there is less overlapping of patterns and therefore greater clarity in the image.





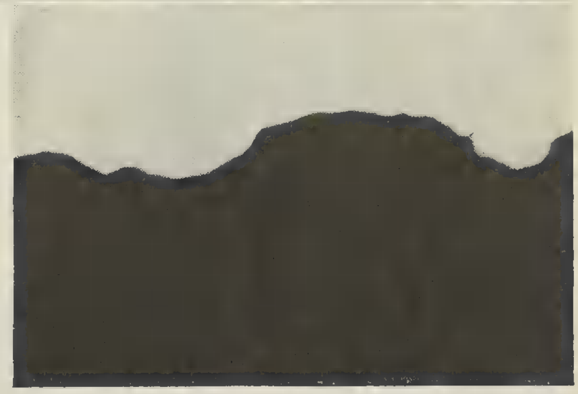


Figure 3, above: Carbon grains of lampblack used in making printers' ink, magnified 100,000 diameters. One of the best electron microscope photomicrographs ever made. *Figure 4, upper right:* A diphtheroid bacillus. *Figure 5, right:* Edge of a new razor blade, magnified 24,000 diameters. All three figures were made at the University of Toronto

THE resolving power of any microscope is the shortest distance two points of a specimen can actually be separated and still appear as two distinct points in the image. We have already said that this shortest distance cannot be less than the half wavelength of illumination. Thus, with visible light of 4000 angstroms, you cannot get a clear, detailed image of anything much smaller than 2000 angstroms or .00002 centimeters (1/125,000 inch) in diameter. With ultra-violet light you may get down as far as 1000 angstroms. But now, with high speed, short-wave electrons, it has become possible to observe objects and details of objects smaller than 100 angstroms in diameter — that is, about 1/2,500,000 of an inch.

A good example of the electron microscope's power is Figure 3, a photograph of the carbon grains in ordinary lampblack. The individual grains are completely invisible in the most high-powered light microscope or even in an ultraviolet microscope. At best, these microscopes show the patch of lampblack only as an irregular, solid, black blob. But illuminate the patch with short-wave electrons, and it resolves itself into a myriad of particles, some of them as small as 30 angstroms in diameter—about 1/8,000,000 of an inch! This photograph was made with the new University of Toronto super-microscope, by James Hillier, one of its designers. The total magnification is 100,000. This, however, was reached in several stages; and here a word about magnifications:

In order to be distinguishable on the photographic plate, the smallest details of the final image must be several times larger than the chemical grains that make up the film. These are about .001 centimeter in diameter. If the smallest detail of Figure 3 is 30 angstroms (.0000003 cm.) it must therefore be magnified some 10,000 times (up to .003 cm.) if it is to appear on the film at all.

But, in order to be visible to the unaided eye, objects must be at least as large as .02 cm.—about 1/125 of an inch. Therefore, the .003 cm. detail of the microscope photograph must be enlarged up to .02 cm. — a magnification of 6.7 times. This is done by enlarging the microscope picture by ordinary dark-room methods.

The total *useful* magnification is then 10,000 x 6.7, or 67,000; this *represents the total enlargement necessary to make the smallest detail visible to the unaided eye.* Further magnification only makes the picture a more convenient size for study. In some cases it is possible to accomplish the whole useful magnification with the electron microscope, but for technical reasons it is easier to keep its magnifying power under 20,000 and supplement it with optical enlargement.

Figure 4 is a diphtheroid bacillus, also photographed by Hillier with the Toronto instrument. The bacillus, magnified 35,000 times, is about to divide in reproduction, as shown by the slight constriction of its waistline. Such a photograph is again utterly beyond the scope of even the best optical microscopes. An enormous number of other organic and inorganic minutiae—bacteria, viruses, crystal structures, colloidal particles and the like—fall within a size range of from 1000 down to 10 angstroms, or 1/250,000 inch down to 1/25,000,000 inch, and it is in this range that the electron microscope has already proved itself so valuable.

IT may well be asked why X-rays or gamma rays, with wavelengths as small or smaller than electrons', could not be used for the same purpose. The answer is that no one has ever been able to devise a lens that would focus them. Though they belong to the same family of electromagnetic vibrations as light, they are too short-wave to be refracted appreciably by glass, as is light. (It is true that X-rays are very useful in examining the minute intricacies of crystal structure, but the method is entirely different from microscope technique.)

The electron microscope is less than a decade old, for its development, which has recently reached practical fruition, began only a few years after the proof in 1927 that electrons have wave properties. The first steps were experiments showing that an electron beam can be

* For example, Valasek's "Elements of Optics"—*Ed.*

focused by a magnetic or electrostatic field, providing the field is symmetric around the axis of the beam. The curving of electron paths in such fields is analogous to the bending or refraction of light rays as they pass through glass; and the field enclosed by a charged hollow cylinder or a solenoidal magnetic coil is thus analogous to a glass lens.

The first electron microscope having magnetic fields as lenses was begun in Germany in 1931 by Knoll and Ruska. Not until 1934 was it perfected enough by Ruska to show a definite superiority over optical microscopes. Since that time various physicists have been toiling to remove still more of the kinks and further improve the design and performance of the instrument. The most notable achievements to date are the three magnetic super-microscopes completed since the spring of 1939—one in Canada, one in Germany, and the latest in the United States.

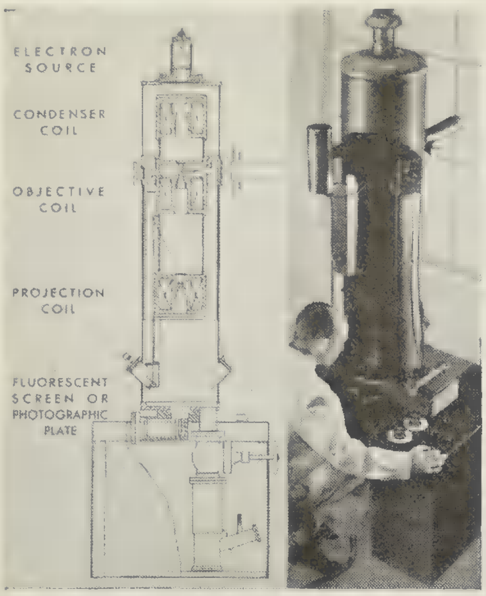


Figure 6: **The electron microscope at the RCA laboratories. Electrons from top are converged by condenser coil, traverse specimen (introduced through an air lock) above objective coil. This coil magnifies image to 100 diameters. Projection coil re-magnifies this image 250 diameters. The image is observed through two diagonal side-windows**

Figures 3, 4, and 5 were taken by the Canadian instrument and give hints of the new world into which the electron microscope affords view. Figure 3, showing a resolving power better than 30 angstroms and a useful magnification of 67,000 diameters, is one of the best electron microscope photograph so far published. Designed by Hillier and Prebus under the direction of Prof. E. F. Burton of the University of Toronto, the Canadian instrument uses lenses of a radically new design.

Last fall the pioneering Ruska and his co-worker, von Borries, developed for a German research institute a microscope with a resolving limit of 50 angstroms, magnifying up to 56,000 times. Little word has been heard of its progress since then, but it is capable of excellent work.

The third and latest super-microscope has just been completed in the Camden laboratories of RCA, an important American center for studies in electron optics (a field which applies to radio and television as well as microscopes). Intended largely for commercial use, the instrument has been developed under the direction of Dr. V. K. Zworykin. Its designer is Dr. L. Marton, another pioneer in electron microscopy, and the first to apply it to the study of biological specimens. This instrument, although it does not differ from the others in its fundamental principles, incorporates a number of new features of design and construction. The limit of resolution which can be obtained is at least 50 angstroms.

LOOKING back now at the lower part of Figure 1, let us trace the path of the electron beam through the electron microscope more in detail. The whole instrument is enclosed with air-tight fittings and pumped free of any gas which might interfere with the passage of electrons. In this high vacuum, the cathode, *F*, and anode behave something like a radio or thermionic tube. The cathode—a metal filament or coated metal plate—is the source of the beam, emitting electrons as it is heated by an electric current. The anode is a metal plate kept at a high positive potential—perhaps 50,000 volts—which attracts the electrons and accelerates them to a high speed. A tiny hole in the anode lets through a narrow beam of these 50,000-volt electrons (wavelength: .055 angstroms). The magnetic lens shown in cross-section at L_1 concentrates the spreading beam into parallel rays that fall on the object at *AB*.

The object—suppose it is the diphtheroid bacillus of Figure 4—has to be supported somehow, and its support must be so thin that it doesn't interfere with the passage of the electron beam. A collodion film 150 angstroms thick (about three five-millionths of an inch) is a common choice, corresponding in function with the glass slides used for ordinary microscopic specimens.

As the beam falls on the specimen at *AB* in the lower part of Figure 1, some of the electrons are absorbed and some are scattered, in proportion to the thickness or density or other properties of the various parts. The transmitted electrons correspond to light of varying intensity reflected into your camera by an object you are photographing; these are what produce the areas of light and shade on the film, and constitute a negative of the final picture.

The transmitted electrons pass on through the magnetic lens L_2 to form a somewhat magnified image of the bacillus at *A'B'*. In the early stages of the microscope, this was the final image and the one that was photographed. But, as the instrument was improved, another magnetic lens (L_3) was added to give still further magnification.

The final image at *C'D'* is usually photographed, but under certain circumstances can be seen visually. If a fluorescent screen is placed at *C'D'* the electrons impinging on it cause it to glow in the pattern of the image. This can be observed through a viewing window cut in the wall of the microscope. By watching this picture, and moving the specimen, it is possible to search for interesting organisms or structures. If one of sufficient interest is found, it may be photographically recorded for closer scrutiny by merely lifting the fluorescent screen out of the path of the electrons, so as to allow them to fall directly on the photographic plate. However, since .02 cm. is the limiting size of objects seen visually, and if the fluorescent screen is used, the microscope must accomplish the whole useful magnification without any supplementary optical enlargement to clarify details.

It is quite possible to use the cathode itself as a specimen, and let it take a picture of itself with the electrons it emits as it is heated in a vacuum. In this case, no object is put between the cathode and the photographic plate. A similar optical example would be to photograph the hot filament of an electric bulb with an ordinary microscope, using the light of the bulb for illumination. Very valuable studies of the surface structure of various cathode metals have already been carried out, with series of electron microscope pictures showing how the structure changes as the cathode is heated to different temperatures.

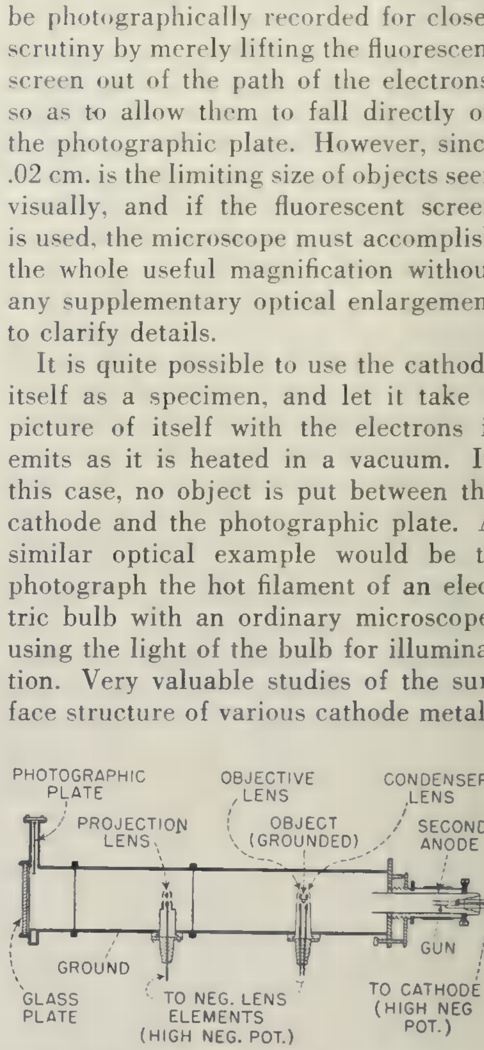


Figure 7: **An electron microscope which uses electrostatic fields instead of magnetism to bend its rays**

It has been stated that either magnetic or electrostatic fields may be used as lenses. Thus far we have chiefly discussed the magnetic model, which is at present the type most used for high magnification studies of specimens which do not themselves emit electrons. The electrostatic microscope has not in the past received as much attention in spite of the fact that it was first developed (by Brüche and Johannson) about the same time as Knoll and Ruska began working

(*Please turn to page* 32)

SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editor
ALEXANDER KLEMIN

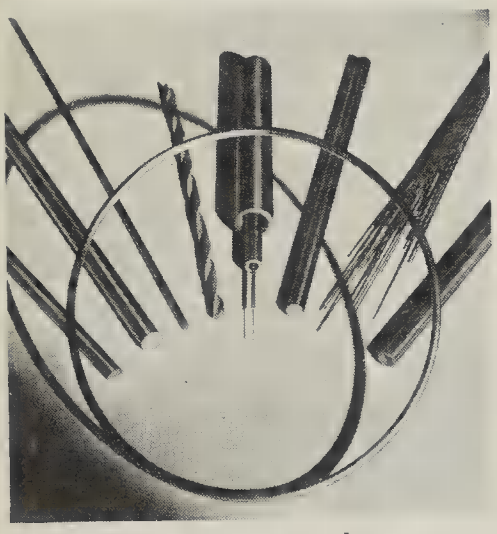
In charge, Daniel Guggenheim School of Aeronautics, New York University

Coal and Kilowatts

WHILE three to five pounds of coal were required to generate one kilowatt hour of electric power 20 years ago, points out M. W. Smith, vice president of the Westinghouse Electric & Manufacturing Company, improvements in generators, turbines, boilers, condensers, and stokers have increased efficiency until today the coal consumption of some of the new high-pressure, high-temperature steam turbine generating stations is less than one pound per kilowatt hour. "Other means of power generation," he added, "are now being considered which show the theoretical possibility of cutting in half even this low value of fuel consumption."

Carboloy Extrusion Process

CARBOLOY cemented carbide now can be produced in the form of tubing, spirals, and round or shaped bars by means



Carboloy in many shapes

of an extrusion process, it was announced recently by Carboloy Company, Inc. Available in lengths up to 20 inches and within a diameter range of from .015 to 3/8 of an inch outside diameter, these rods, spirals, and tubes are considered a distinct innovation compared with previous practice. Formerly such parts were available only within an extremely limited size range and it was necessary to perform a large part of the shaping operation manually. With the new process now employed, the Carboloy parts are formed directly into the shapes desired, eliminating most of the customary hand forming operations.

To those familiar with the limitations ordinarily encountered in working cemented carbides, the Carboloy tubing now produced is of especial interest. This can be made as small as .060" outside diameter by .030" inside diameter, leaving a wall thickness of .015".

The limitations have been overcome by the development of a new process of extrusion. By this process the dry powder is mixed with a plasticising medium and can then be formed by extrusion or molding into almost any shape.

Particularly interesting is a supplementary process, by means of which Carboloy rods, and so on, can be bent to various shapes. The 5-inch diameter ring illustrated was produced through this process. It consists of a round rod curved to form a ring, with the ends joined together.

Gage Measures Lacquer and Thin Paper

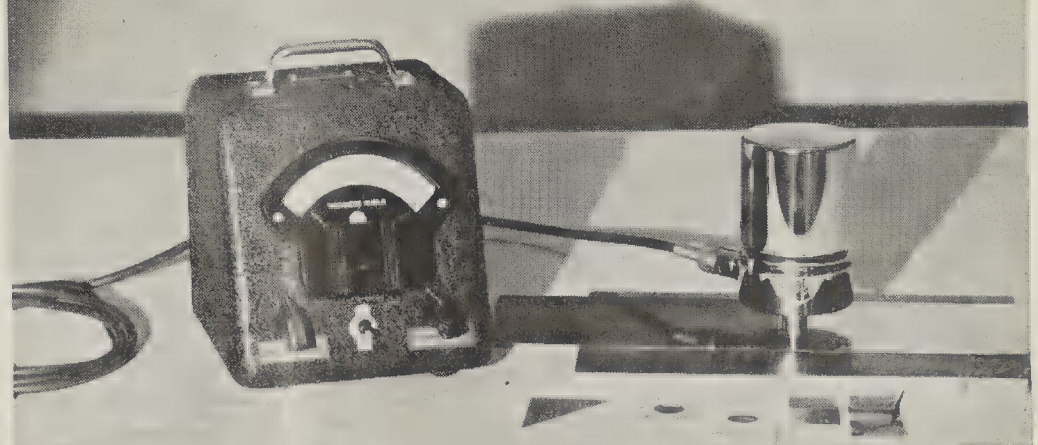
AN electric thickness gage, designed by General Electric engineers, has a full-scale range from 0 to 0.0007 for measuring non-magnetic coatings on steel and can measure coatings of lacquer only 0.0001 of an inch thick, such as that used in the canning industry on the thin sheet-iron of the cans.

Thin paper, as used in the manufacture of capacitors, and even thin electroplatings on steel can also be measured. The gage will measure a deposit of 0.0001 of an inch thickness on ordinary commercial tin-plated flat sheet stock to a plus or minus 25 percent accuracy, and heavier coatings are measured to a much greater degree of accuracy. To obtain the correct gage response, the material to be measured must be backed with magnetic material to serve as the magnetic-flux return for the gage.

Prevents Shock in Surgical Operations

SAFER surgical operations and speedier recovery from them, especially for debilitated patients, seem promised by a new treatment for preventing dangerous shock during and after operations. The treatment, using a synthetic adrenal gland hormone, was developed by Dr. David Perla, of Montefiore Hospital. Striking benefits in 14 cases at this hospital are reported by Dr. Perla, who said that the treatment will shortly be adopted in two other New York City hospitals.

The patients treated at Montefiore were what would be considered poor surgical risks because serious chronic illnesses such as cancer and tuberculosis had weakened them so that they would have little strength to withstand an operation. With the new treatment, patients are prepared for opera-

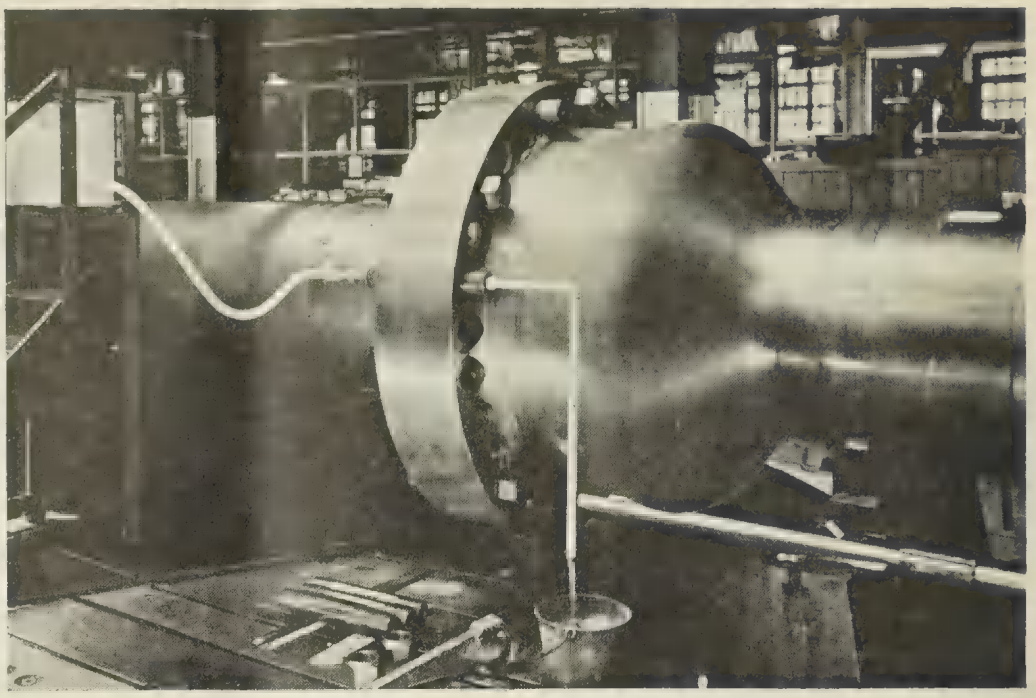


Non-magnetic coatings on steel are accurately measured with this set-up

tion by being given quantities of salt solution and carefully prepared doses of desoxycorticosterone acetate. This chemical is the synthetic vital hormone of the adrenal glands. Earlier studies have shown that these glands play a significant rôle in the body's fight against intoxications, poisons, shock, and infections. The adrenal cortical hormone, Dr. Perla explained, influences the transfer of water from tissues to cells and the level of salt in tissues and cells. Disturbance of this glandular balance, which frequently occurs in an exhausting operation, leads to collapse.—*Science Service.*

SCOOP

TANKS between the rails from which railroad locomotives scoop up water without coming to a stop were first used in 1872.



Alcohol, cooled by dry-ice to 40 degrees below zero, Fahrenheit, is used for shrinking the bolts in this water-power coupling assembly so that they may easily be removed from their carefully fitted holes. The assembly shown set up in the shop of Allis-Chalmers Manufacturing Company, is a huge coupling for connecting the water wheel and generator shafts of one of the three 30,000 kva generator units for Chickamauga Dam. The tank containing the dry-ice and alcohol may be seen at the left. In assembling such couplings, the bolts are first shrunk by placing them in a box containing dry ice

Fade-Proof Interior Finish

THE Wood Conversion Company has just announced Kolor-Fast Nu-Wood as an improvement in insulating interior finish. This new product is the first of its type for which fade-proof qualities are claimed. These claims are based on severe tests by nationally recognized laboratories, which tests have established the light-fast qualities.

Nu-Wood Kolor-Fast is available in tile and plank in variegated and tan colors. Nu-Wood Kolor-Fast Board is available in tan. The colors are richer and clearer than before. The over-all colors are slightly lighter, giving the material a higher light reflection value in keeping with the modern tendency in interior decoration.

Heretofore, all insulating interior finish board materials have been subject to oxidization which resulted, over a period of years, in darkening of the material.

Rod-Lights for Industry

SEEMINGLY there is no end to the light transmitting uses of Lucite. Sometime ago we discussed in these pages new flash lights for medical examinations which used Lucite rods to carry the light into such close spaces as a patient's throat. An accompanying illustration shows a number of new forms of Lucite flash lights developed by Dr. D. L. Weiss for wide use in industry and repair work.

Dr. Weiss's development makes use of a small fountain-pen-size flash light, or a handle of the same shape connected to a small transformer which, in turn, is plugged into an alternating current socket.

Light-conducting rods of various shapes used in flashlight (center)

Various types of this new unit, called Ang-Lite, are being used in many manufacturing operations to examine assembly of complicated apparatus. The light travels down the Lucite rod and is thrown off in a bright spot at the tip. Instrument makers and repair men can examine with these units parts of their equipment difficult to get at. One type, having a rubber-mounted magnifying glass, throws a light directly on textiles, printing, or other surfaces to be examined. Other forms of these rods, fluted spirally in order to throw a glow of light throughout their length, are used for mixing operations or to observe chemicals in a mixture. In the photographic darkroom Lucite rods of proper color may be used not only as working lights but also as a means of stirring the photographic baths and throwing a glow of light directly on negatives and prints that are being developed.

New World's Record Pressures

NEW world's record high pressures, as much as 3,500,000 pounds per square inch, have been achieved by Dr. P. W. Bridgman in Harvard's Physics Laboratories through use of nests of high pressure vessels in which inside apparatus receives outside support at critical parts.

A piece of tool alloy, Carboloy, composed of tungsten carbide and cobalt, was subjected to a compressive stress of between 2,800,000 and 3,500,000 pounds per square inch, without fracture. Carboloy's crushing strength under normal conditions is not more than 1,000,000 pounds per square inch.

Dr. Bridgman, in reporting his results to the *Physical Review*, also made known that under such extreme pressures, carbon in the form of a thin plate of crystal graphite is not converted to diamond at room temperature. There had been hope that pressure alone might cause the formation of diamond out of this form of carbon. "It is probable that no pressure, however high, will accomplish the conversion at room temperature," Dr. Bridgman now concludes.

A striking effect of the extreme high pressures on Carboloy was that, although under normal conditions it is highly brittle and breaks with practically no plastic deformation, under the confining pressures used by Dr. Bridgman the piston of this tough material was plastically and permanently shortened by 5.5 percent with no perceptible cracks.—*Science Service.*

Paint-Receptive Aluminum

UNTREATED surfaces of aluminum and its alloys possess no natural affinity for paint, lacquer, or enamel coatings. Ordinarily such finishes will not adhere permanently. Use of aluminum has, therefore, been limited to those products on which no coating is desired.

In the Metal Finishing Laboratories of the Pyrene Manufacturing Company a simple process has been developed for the treatment of aluminum so that it will take these finishes. This process, which has proved so satisfactory under ordinary plant production conditions and whose flexibility is demonstrated by its successful use on a wide variety of parts such as microphones, transmitters, instrument panels, switch parts, has been named the Pylumin process.

Pylumin powder is a mixture of several chemicals which, when dissolved in boiling water, forms a solution that reacts quickly upon aluminum, converting the surface into a non-metallic film of complex basic oxides, thereby forming a coating which is highly resistant to corrosion and also serves as a

Official photograph, U. S. Navy

Grumman *Sky Rocket*, designed for operation from naval aircraft carriers

base for paint, lacquer, or enamel finishes. Pyluminized metal is of a uniform gray to black color, depending on the composition of the metal treated, and is velvety in texture.

The Pyluminizing operation involves only the simple immersion of parts in a heated solution in a steel tank. The processing action is fast, requiring only three to ten minutes immersion in the boiling Pylumin solution.

First Tests of The Grumman "Sky Rocket"

THE construction of the Grumman *Sky Rocket*—the XF5F-I, to call it by its Navy designation—was undertaken by the Navy Department well before the war broke out in Europe, when it became apparent that high performance fighters with long range and endurance would be required to accompany heavy bombing airplanes on long flights. The European war confirmed the Navy's viewpoint. Long-range bombers operate best if supported by fighters of equal endurance.

The XF5F-I is a carrier-fighter and has the control, maneuverability, and relatively small dimensions necessary for operation from the deck of an aircraft carrier. Although it is equipped with two Wright engines of 1200 horsepower each, it has a gross weight of only 9000 pounds, and a span of only 40 feet. The square wing tips and the square tail surfaces are intended to increase production possibilities without detracting from aerodynamic efficiency.

Although the new ship has been released for sale to the French Air Commission, definite information regarding performance is lacking. Take-off occurs in about seven seconds. In one of the tests the *Sky Rocket* flew about 100 yards in advance of a standard pursuit and suddenly began a steep climb which the older craft was unable to duplicate. Climb was said to be 4500 feet a minute without full power. Top speed is reported to be 450 miles per hour, a figure which is at least plausible. It is noteworthy that the two Curtiss controllable-pitch propellers of 10 feet diameter rotate in opposite directions. We have often in these columns pointed out the desirability of twin engined propellers turning in opposite directions. Both control and stability, and the aerodynamic efficiency, are improved thereby. Altogether, there is no doubt that the new machine will be a worthy and gratifying addition to the air equipment of the Allies.—*A. K.*

A Plea For Many Small Landing Fields

IN a recent speech, Robert Hinckley, Chairman of the Civil Aeronautics Authority, deplored the short length of time that the private owner keeps his ship before reselling it. Four out of five of the men who buy private planes sell them within a period of two and one half years, and do not buy other planes. One third of such owners actually dispose of their craft in one year without purchasing another. This is a deplorable situation and in sharp contrast to the case of the automobile, where a man who has once owned a car will mortgage his home if there is no other way of buying a new one. Mr. Hinckley thought that the situation was due to a combination of several factors, possibly too many log books and inspections, possibly too few small airports and landing fields.

The lack of small landing fields is indeed a very important reason. At least so thinks Jerome Lederer, well-known Chief Engineer of Aero Insurance Underwriters. We cannot resist quoting part of what Mr. Lederer had to say at the North Central Regional Planning Conference: "At present the private pilot may be likened to the owner of a little sailboat in a stormy area with very few harbors to run to for safety. Only the more venturesome will dare to risk a sail along the forbidding shore . . . If only there were small inlets along the shore, not necessarily large harbors, these less venturesome folks would try coastwise sailing too, and have more fun. Likewise, the private pilot does not want large airports. Small landing fields located at frequent intervals in every direction would furnish much greater incentive than now exists to make cross-country flights. These fields would furnish men much more chance of getting down safely if bad weather were encountered, besides giving the private pilot greater opportunities to use his airplane."

La Guardia Airport has been criticized for charging large landing fees. We believe that the authorities of this Airport are perfectly right in so doing. Promiscuous use of the transcontinental airports would make air-traffic control difficult and increase hazards. What is needed is a nation-wide movement for a multiplicity of small fields, and every reader who can in some manner encourage the construction of such fields will be a welcome ally to the cause of private flying.—*A. K.*

The First Central Air Terminal

IN a personal interview with Floyd Del Brown, architect and President of the Bethlehem Engineering Corporation, we obtained details of the new central air terminal which is being constructed on the site of that famous and friendly old hotel, the Belmont, just across the way from Grand Central Station, New York City. The terminal is a splendid example of what American brains, business men, architects, and engineers working together can do in combining functional design with desirable sober beauty.

The artist's drawing of the new terminal building shows its dignity and beauty. Five companies will have their offices and passenger facilities within the one structure—T. W. A., United, American, Eastern Air, and Pan American. The building cost will be $1,500,000, on a piece of land estimated at some $5,000,000. Tenancy will be for a period of 10 years; the air transport industry is growing so rapidly that a structure twice as big as Grand Central Station may then become necessary.

In the new building there will be a basement for garage purposes and another basement completely fitted as a passenger terminal. On the first floor there will be a motion-picture theater and stores, with the mezzanine used for ticket reservations and so on. The second floor will be the main departure terminal. The third and fourth floors will house the offices of the five airline companies.

The main hall will be three stories high,

New York's central air terminal

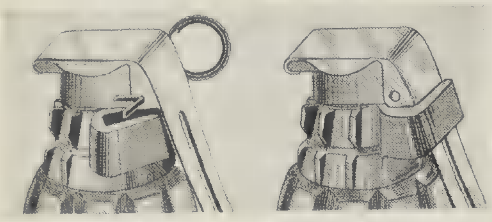
160 feet in length, and 100 feet in width. There will be six platforms side by side, with hydraulic platforms for raising the passenger buses. Passenger coaches will discharge passengers at the incoming terminal, proceed to the garage for minor attention, and will then roll on to the hydraulic lifts and be raised to the departure platforms. A minimum amount of attention will be required as doors and elevators will all operate automatically. The whole will constitute a remarkable system of "uniflow," as the engineers call it in steam-engine design. Not only will there be a minimum loss of time and a minimum expenditure in handling coaches, but there will be avoided the sorry spectacle of airline coaches parked along the street near some small and insufficiently equipped ticket office as at present.

The building, which runs from 42nd to 41st Streets, will have its bus exit on 41st Street. With but three blocks of city traffic, the coaches will then be at the entrance to the Third Avenue Long Island Tunnel. Then Queens Boulevard and La Guardia Airport will be within easy reach. It is estimated that no more than 20 minutes will be required for the entire trip.—*A. K.*

Hand Grenade Safety

THE layman will not think of humanitarianism in connection with a hand grenade. Yet that is the essence of a new locking device for hand grenades developed by Norwalk Lock Company, Division of Segal Lock & Hardware Company, Inc.

Often a soldier has occasion to pull the pin from his hand grenade many seconds



or perhaps minutes before he may need it — in a charge against enemy trenches, for example. Should he then find that the trench already has been mopped up, he must dispose of the hand grenade somehow, for the minute he releases his grip on the metal handle, the firing pin snaps over and in five seconds the grenade explodes. Only too often have soldiers been blown to bits by their own hand grenades.

The new development consists of a metal collar around the neck of the grenade. A projecting arm is so bent that a slight turn of the collar with the thumb of the hand holding the grenade pushes this arm around to hold the detonating cap holder in cocked position. A number of fins on the collar provide a positive grip for the thumb.

Twins More Likely to Older Parents

IF you are an expectant father, your chances for having twins instead of one son or daughter are greater with each year of your age, it is revealed by a statistical study conducted by the National Institute of Health and reported to *Human Biology* by Drs. J. Yerushalmy and S. E. Sheerar.

Older mothers are more likely to give birth to twins than are younger women. And twin births occur with much greater frequency in families already large than they do as first or second births.

But the fact that older fathers are more likely to have twins cannot be explained by the fact that older women are more likely to have older husbands. When only the births to young mothers are considered, there is still a steady increase in the proportion of twin births to total deliveries with advancing age in the father.

The influence of age in father and mother and order of birth, although showing up clearly when all twin births are considered, seems to apply principally to the births of non-identical twins, those resulting from a double ovulation rather than the dividing of a single egg cell. — *Science Service.*

PULLMANS

AN average of approximately 32,000 persons sleep every night in Pullman berths on American railroad trains.

The Pittsburgh of Old Palestine

IN our January issue, Director Nelson Glueck, of the American School of Oriental Research, Jerusalem, described excavations at an arm of the Red Sea, which had brought to light a buried city with a smelter in which King Solomon refined his copper. A second season of excavations at the same site has revealed that there was a much more extensive system of similar refineries than had previously been expected. Indeed, practically the entire town of Ezion-geber proves to have been a phenomenal factory site, of a nature unparalleled in the history of the ancient Near East, according to the same archeologist writing in *American Journal of Archeology.*

Flower Watering Gage

A NEW and inexpensive device for determining the amount of moisture required by potted plants and by seedlings in seed flats has been introduced by Fabaco Company, Inc. Known as the "Soil-Rite" watering gage, it is placed in pots or flats deeply enough so that its point is in close proximity to the roots, thus registering the degree of dryness or moisture at that depth on a scale. Acting as the "voice" of the plants, this gage takes the guesswork out of watering, a problem that has been the death of many a plant. A chart lists some of the more popular desert plants, those requiring moist soil, and those that do well only when the soil is wet, so that one knows the moisture requirements of the more common plants and will not under-water or over-water them. — *C. F. Greeves-Carpenter.*

Soil-moisture indicator

New Ships for Merchant Marine

IN May there was launched at the Newport News Dry Dock and Shipbuilding Company, the steamship *President Jackson*, first of a new series of ships being constructed for American President Lines Round-World Service. Other Presidents to be honored by this series will be Adams, Monroe, Jackson, Van Buren, Polk, Hayes, and Garfield.

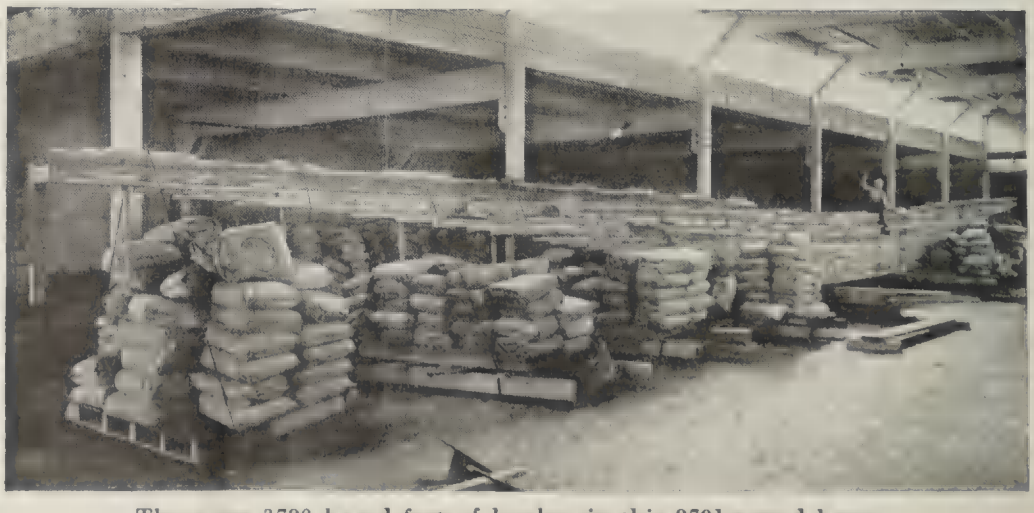
These new ships will be of 9300 tons gross, 492 feet long, 69.5 feet beam, and have a speed of 16.5 knots.

Largest Wooden Beam

AN accompanying illustration shows the largest laminated wooden beam ever built. This beam owes its existence to Laux Self-Bonding Glue with which it was fabricated in the plant of the Speedwall Company in Seattle.

Regular two by ten's of a maximum length of 20 feet made up the laminations in this beam which contains a total of 3780 board feet of lumber. Of the self-bonding casein glue, 118 pounds were necessary, while only enough nails were required to insure adhesion while the glue was setting.

The beam is 110 feet long, 10 inches deep



There are 3780 board feet of lumber in this 8791-pound beam

at the ends, and 52 inches at the center. Weighing 8791 pounds, it is capable of supporting a roof load of 65 pounds per square foot of roof. In our illustration, the beam is being tested under a load of 650 pounds per lineal foot.

FIREPROOF

THROW all the cigarette butts and lighted matches you want to on a new awning and it never burns. It is woven of fiber glass yarn. Besides being fire-proof, it is rot-proof and will not mildew.

Mending Cement

A LATEX cement, which is being sold under the name Liquid Thread, mends fabrics, paper, leather, or leatherette, and adheres to such non-porous materials as glass. Used on fabrics, it provides a heat-proof and water-proof mend, and is said to be unaffected by washing and ironing. Liquid Thread is made by Paste Elastic Manufacturing Corporation.

It may be used for joining or binding rugs and, when applied as a coating, it imparts anti-skid qualities to rugs, telephone bases, and similar objects. It also finds use as a general adhesive in the office, home, and school.

A Problem for the Resourceful Inventor

THE skin prevents the escape of body fluids. Its thickness varies in different parts of the body. It is freely movable in some places and tight in others, and the creases mark where it is bound down. It has minute ridges which improve the grip on the palm and sole and marvelously afford the only permanent and absolute means of personal identification with finger prints.

With all our modern ingenuity in creating machinery and fabrics, we cannot create a tough yet highly elastic one that will withstand heat and cold, wet and drought, microbes, and the wear and tear through the years and yet make its own repairs and even assemble in summer a protective pigment against the sun's rays. The skin is a regulator of body temperature, an excretory organ, and the largest and most versatile of our sense organs. The skin helps to form the ear drum, it covers the eye ball, from it originate the teeth, and in it are millions of tiny glands. Finally, when sunlight or ultra-violet is shed on it, the ergosterol in the skin produces vitamin D.—*Journal of the American Medical Association.*

Roses Treated with Gas from Apples

ARTIFICIAL autumn can be brought to rose bushes, causing them to shed their leaves in a few days, by locking them up in the same room with apples, it has been discovered at Oregon State College by J. A. Milbrath, Elmer Hansen, and Prof. Henry Hartman.

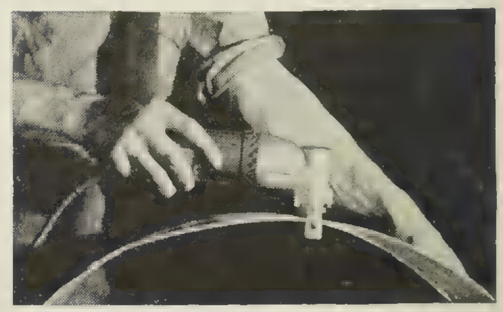
Ordinarily such defoliation would be undesirable, but when large numbers of field-grown rose bushes are being prepared for shipment to market it is necessary to rid them of their leaves, to cut down water loss

through evaporation. Hand plucking is tedious and expensive — a thorny job at best.

By putting the bushes in a tightly closed, moderately heated room, with one bushel of apples to every 300 or 400 cubic feet of space, they can be caused to shed their leaves in about four days. The apples produce this effect because they give off small quantities of ethylene, which is also a common constituent of natural gas.—*Science Service.*

Metal Nibbler

PORTABILITY, speed, and power are characteristics of a new portable nibbler with which all types of sheet metal products may be cut into odd shapes for fitting. This new Thor nibbler cuts panels,



sheets, or tubes up to 18 gage in steel and up to 15 gage in aluminum. It follows line or contour accurately, cuts plain or corrugated stock and will cut tubes as small as 1½ inches in diameter. Operated with one hand, it will not distort the sheet and makes inside cuts easily.

This nibbler is equipped with a universal motor in standard voltages of 110 or 220 volts. Full load input is 200 watts.

Window Cleaning Compound

MEETING the growing demand for a solvent suitable for use in the manufacture of window cleaning compounds, U. S. Industrial Chemicals, Inc., has developed a new concentrated solvent blend that can be diluted with water to make a finished liquid cleaner.

In placing this solvent on the market, U.S.I. has made it possible for manufacturers of cleaners to offer a highly effective product.

All that is needed to manufacture the finished compound is to dilute the new solvent with water. The final compound may contain from 15 to 50 percent by volume of the solvent, as desired. Even the 15 percent mixture is safe for storage in cold weather.

The 50 percent dilution, it should be noted, will affect paint, varnish, and lacquer, and will soften celluloid (such as eye-glass frames). The 15 percent compound, however, may be used safely on such surfaces and is an excellent polish for eye-glasses.

Naval Construction

LAUNCHING of the battleships *North Carolina* and *Washington*, early in June of this year, marked the first launching of a battleship by the United States since the early twenties. Both of these ships should be ready for shakedown trials within another year. The keels of three other battleships—*South Dakota, Indiana,* and *Massa-*

chusetts—were laid in 1939, and the keel of a fourth, the *Alabama*, was laid in February 1940. Two others, the *Iowa* and *New Jersey*, have been let on contract to the New York Navy Yard and the Philadelphia Navy Yard, respectively, and their keels will probably be laid shortly, now that the *North Carolina* and *Washington* are off the ways.

As of March 1, 1940, progress of other naval construction in navy yards and private yards was as follows:

Two aircraft carriers were under construction, one of which, the *Wasp*, has since been placed in service. Contracts have been let for six light cruisers, for one of which the keel was to be laid late in March. Fourteen submarines have been ordered, of which two were launched, two were scheduled for launching in March, and the keels had not been laid for three. Keels had been laid for all except two of 27 destroyers. Nine of these have been launched and two others were scheduled for launching early in March. Keels have been laid on most of the remaining ships comprising tenders, mine sweepers, a repair ship, a mine layer, submarine chasers, and a large number of motor torpedo boats. Of these, two DD tenders, a fleet tug, a submarine chaser, and two motor torpedo boats had been launched.

Label Gluing Machine

SHIPPING rooms of factories, stores and business offices are faced with one slow but always messy job—that of pasting shipping labels on packages. Pre-gummed labels are not only difficult to handle but are expensive. The Glue-Fast Equipment Company, Inc., has worked out a simple gluing machine which operates like many well-known moisteners but which makes

unnecessary the pre-gumming of labels. This machine covers the surface of the label with a thin film of glue.

The operator of this machine uses only one hand to slide the label under the guide bar. Pulled across the roller, the label is gummed so that it can immediately be spread on the package and there is no necessity for wiping off excess glue—there is no excess.

Leather Electro-Plating

THE fad of electro-plating babies' shoes to preserve them, and the manufacture of certain kinds of metallic decorative leather, make the following formula of interest to many of our readers.

All leather to be plated must first be carefully cleaned to remove oils, greases, and the like and then dried and coated with

orange shellac to make it waterproof. An additional coat of shellac or an air-drying varnish is then put on the surface and sprayed or brushed with copper or bronze powder while still tacky in order to make it conduct electricity. Once this has fully dried, the leather is electro-plated in the usual manner in an acid copper solution. Following the copper plating the leather is rinsed, scraped, brushed, or buffed and is then oxidized or plated with the final coating of metal.

This process can be used on wood, plaster, flowers, and other such objects, according to the magazine *Metal Industry.*

New Magnet for Medical Use

A NEW magnet for the removal of metal fragments from the eyes and surface wounds has been devised by the General Electric Research Laboratory in Schenectady. Though not designed to replace the

powerful electromagnets in this field, the new instrument is more powerful and more easily handled than earlier permanent magnets used for the purpose. Sintered alnico, an alloy of aluminum, nickel, cobalt, iron, and copper, is used with a high-permeability insert of nickel-iron to collect the flux at the point. The magnet is light in weight.

RUBBER

THE 1940 rubber requirements of one popular make of automobile would make a single monster tire 346 miles in diameter and 80 miles wide.

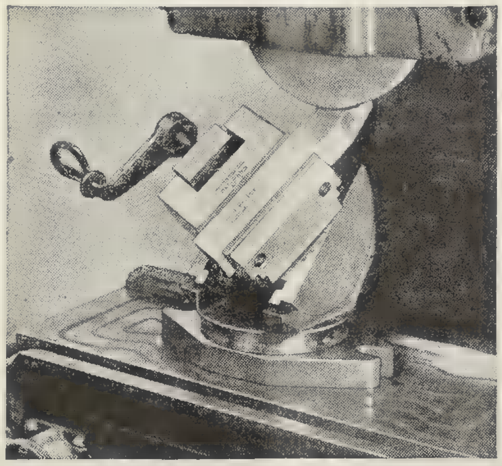
Airplane Armor Plate

WALTER Winchell in his Sunday-night broadcasts has often made the statement that American fighting planes are as efficient as any made in the world today with the single exception that the pilot has no armor-plate protection. The Jessop Steel Company recently reported that they have just completed shipment on a large number of sets of armor plate to be installed in the cockpits of combat planes. These pieces are so placed as to afford protection to fire from below and from the rear. The armor plate for this order was specially heat-treated to procure maximum ballistic resistance to penetration. Consequently, the

gage is comparatively thin and the weight reduced to a minimum while giving protection against machine-gun bullets and shell splinters.

Universal Angle Vise

A NEW type of universal vise for use in connection with milling, grinding, and drilling operations permits easy production of even complicated compound angles. The vise is adjustable in three planes. Graduated scales are provided in each plane so that



the vise may be set up for a complicated angle operation as easily and quickly as for a simple angle.

A special feature of this new vise is its accuracy and ability to handle heavy cuts. The vertical member is built like a cradle; it rocks in a solid base. All-steel construction gives added strength and makes the vise light and easily portable. It may be moved from one machine to another for successive operations without disturbing the work. This vise may also be used as a gage in checking the accuracy of angles which have already been produced.

To Protect Rusted Fences

RUSTED fences present a difficult painting problem. First of all, it is practically impossible to remove the rust and prepare the surface for ordinary types of paints. Furthermore, the links "chafe" the touching pieces of wire and cause the paint to crack and chip away. A new product, Fence-Bond, made by the Skybryte Company, solves these problems.

Fence-Bond is a factory-mixed, ready-to-use aluminum paint specifically designed for painting rusted fences. The factory mixing is said to result in a more uniform dispersion and a more silvery, lustrous surface that will protect the fence despite rust that may be present before the repainting. Chafing and cracking are prevented because the paint remains plastic enough to take up all movement from expansion and contraction or other causes.

Kidney Extract for Gastric Ulcer

HOPE for stomach ulcer patients appeared in a discovery announced at the recent meeting of the Federation of American Societies for Experimental Biology. For these patients there will be the new hormone urogastrone, obtained from kidney excretions. First trials on 10 normal persons showed that this hormone can stop the

formation of acid by the stomach, Drs. A. C. Ivy, E. Wiezcorowski, and J. S. Gray, of Northwestern University Medical School, reported. At present, ulcer patients must take alkaline powders to neutralize the acid in their stomachs so that it will not irritate the ulcers and cause bleeding.

The new hormone will be injected under the skin. Such injections at present cause swelling and reddening. Dr. Ivy and associates hope shortly to overcome this feature by further purification of the hormone, after which it will be ready for use in treating ulcer patients. The hormone treatment, by checking the acid in the stomach, will give the ulcer a chance to heal.—*Science Service.*

AGAR

IN dried form a grayish, light, stringy solid, agar is made solely in Japan because the harvesting of the seaweed from which it is made, and the processing, require much hand labor, which is cheap in that country. Should the supply be interrupted, all manner of research institutions would be handicapped, for it is used almost invariably as a culture medium in research involving germs.

Machine Post Office

A COIN-OPERATED post office, called the Mailomat, has been intriguing commuters and others—with letters to mail at the last minute—in both of New York's great railway terminals. This machine is, in reality, a self-service post office, for if the letter is dropped in with a coin the machine prepays postage and postmarks the letter. No stamps are necessary and it is not necessary to run the mail collected from this box through the cancelling machine at the post office. The Mailomat is manufactured by Pitney-Bowes Postage Meter Company.

Off with Peanut Skins—Chemically

BEFORE peanuts can be used as a food, the unpalatable reddish-brown skin which closely covers the nut must be removed. This has been a problem in the manufacture of peanut products. Home economists in the Department of Agriculture now have developed a commercially practical way to remove the skins with low weight loss and no splitting, and still have a nut high in quality. The shelled nuts are dipped in a 1 percent hot lye (sodium hydroxide) solution for about eight seconds—just long enough to moisten the skins. They are then dipped immediately into a cold, 1 percent solution of hydrochloric acid to reset the dissolved pigment in the skins and thus keep it from staining the nuts. The nuts are then rinsed in cold water and the skins easily removed by hand. The nuts are dried at room temperature before storage.

Peanuts skinned in this way retain their smoothness and gloss and keep much longer than those blanched either with hot air or hot water. The weight loss is low — 3 to 6 percent as compared with around 18 percent for the usual commercial hot-air treatment.

SEEING WITH ELECTRICITY

(Continued from page 22)

on magnetic lenses. The principle of this type of instrument is shown in Figure 7, a diagram of an electrostatic electron microscope now under construction in the Camden laboratories of RCA. Here radially symmetric electrostatic fields between suitably shaped apertures serve as lenses. While the actual construction of the instrument is quite different from that of the microscope described, the operation is quite similar. These electrostatic lenses now appear to be capable of the same high magnification as the magnetic lenses, but the ultimate resolution that can be obtained with them has yet to be determined.

We could hardly leave the subject of the electron microscope without giving at least a sketchy account of some of the difficulties which beset it. Any microscope, optical or otherwise, is allergic to certain "bugs" in the works, some of them inherent in the illumination itself, and most of them leading to distortions and aberrations of the image.

Among these is diffraction, which we have already mentioned, explaining how it limits the resolving power and tends to blur the image. But present-day electron microscopes still have a long way to go before they attain their theoretical resolving limit of half the wavelength of the electron. Even so, the fact that, for a given specimen, diffraction effects decrease with wavelength, gives the electron microscope an advantage over the optical instrument. As large a part of that theoretical advantage as can be exploited practically is being sought for use.

Figure 5 is an electron microscope photograph of the edge of a new razor blade, magnified 24,000 times. The section of blade pictured is .00003 cm. (about 1/83,000 inch) across—a distance within the scope of good optical microscopes. But, had the latter been used, diffraction would have blurred the indentations of the edge, and the picture would lack the detail and exquisite clarity of line given by electrons.

With present electron lenses, a number of errors other than diffraction are of great importance, and keep the resolving limit far above its lowest theoretical value. Distortions of the image result if the electric or magnetic field lenses are not perfectly symmetrical or constant; if the accelerating potential varies even by a volt or two; or if the velocity of the electrons is slowed too much by passing through the specimen and its mounting. Once again, each of these electron lens errors has an analogue in optical lenses: spherical aberration, chromatic aberration, astigmatism and so on.

The proper mounting of all types of biological and physical specimens also presents a problem which is at present far from being solved. The men working on it have been successful in mounting a number of types of bacteria, colloidal particles, and other physical specimens, but the extension of the list and the interpretation of the images is more difficult. However, when one considers that, after a century of work, the corresponding problems of light microscopy are far from complete solution, the development of the super-microscope and its associated technique appear almost phenomenal.

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

OPTIMUM is the word to characterize the Richest-Field Telescope, which affords a optimum broad view of the heavens.

"I enclose a photograph (Figure 1) of a 6", short-focus reflecting telescope made for me by two friends, W. F. Gale in the chair," writes G. H. Hoskins, of Ewarra, Brewongle, New South Wales, Australia. "My interest was aroused by a chapter on 'The Richest-Field Telescope,' in your book, 'Amateur Telescope Making—Advanced.'

"The telescope is 30" long over-all, focal

Figure 1: RFT made in Australia

length is 24", mirror is 6" diameter, Ramsden eyepiece, magnification 19 diameters, field of view 2°.

"It struck me, when suggesting its construction, that the design could be made more comfortable to use, hence a leather-covered pad was attached to the base, so that the telescope could sit easily on a rather bony knee—it also helps to take up vibration. The eyepiece is just at the right height when one is sitting in a chair. A door handle is attached to the tube, to allow safe carrying, but it also gives a remarkably steady hold when observing—the telescope is steadier than a binocular. Another part of the apparatus, and a most useful one, is the alt-azimuth mounting shown. This is extraordinarily good.

"I have used telescopes, up to 18", but in none of them have I seen such comprehensive and beautiful views of the heavens. As a comet seeker it would be hard to find its equal and, for ease of use, I know of no other unmounted telescope to approach it. All thanks to 'ATMA.' "

Thanks mainly to S. L. Walkden, father of the RFT.—*Ed.*

ENDLESS and largely futile has been the age-old debate between exponents of the refracting telescope and those of the reflector. After years of near ostracism by American amateur telescope makers, the refractor is now in the social swim, thanks largely to J. R. Haviland's lengthy and detailed treatise in "ATMA." An amateur whom we shall designate as X, because he prefers to be anonymous, has completed a 7½" refractor (Figure 2) and says he enjoyed the job, also likes the telescope.

X says he feared to begin the 7½" objective lens as his maiden refractor job but, after a talk with J. R. Haviland, he felt encouraged to wade in. The 8" flat required in testing the objective, good to a quarter wave, was successfully completed in 150 hours. Then came the actual objective. "It definitely was not difficult," states X. "The edge testing jig and spherometer described by D. Everett Taylor, in the February, 1940, Scientific American is the thing. However, I found the three-ball jig recommended in 'ATMA' by Haviland was good. Using a Starrett gage on the Taylor equipment, it was necessary only to take a little care and use patience to get the crown and flint to radius and the edges within the limit of accuracy of the gage. This eliminated the bugbear of centering.

"To avoid scratches I ground glass blanks to the same radius as each curve and used these to break in the pitch laps. Figuring was rather baffling until I tried Ellison's stunt of putting a heated flannel pad in the center of the back of the flint to indicate definitely what a hill should look like, then varying lap and stroke accordingly. To save making King's test for convexes I drew on my flat-making experiences and interpreted the fringes against the concave; for this the concave should be a true surface with a clean edge. I finished No. 1 surface one fringe off, and No. 2 about three off, but this was cemented to the concave.

"The objective required about 225 hours of actual work. It is second grade Jena and of course has some striae (a pair of guaranteed discs would have cost probably five times as much.) Strange to say, it is difficult to trace any irregularities to the striae in actual performance, though in the collimation tests they stood out like a sore thumb. Under test on the stars the glass is quite satisfactory. There is much less scattered light in the field than in my reflector. The planets and, particularly, the Moon's detail, stand up much better under high power."

John R. Haviland, author of the chapter on objective lens making, in "ATMA," states that he has tested this objective against his 10" flat, and that it tests first-class and has a beautiful polish. The anonymity of X is not of his own choosing, it isn't due to shyness, and the G-men aren't after him! Your scribe will forward to him private letters from readers, if addressed in care of this department.

William R. Harlow, 328 Fisher Hall, Oxford, Ohio, states that he made a 7¾" objective lens, working from Haviland's chapter in "ATMA," which he praises, the job lasting from November to May. "The biconvex crown part was easy," he says, "but I had trouble with the back surface of the flint. The unit was quite a bit over-corrected and had to be separated by about 0.1". The definition of the image then was somewhat spoiled by the light reflected back and forth between the surfaces. All in all, the lens is all right," Harlow continues, "but I will stay with smaller ones after this."

A 3" is usually about the best size objective for a maiden job, (at least one previous reflector having been made). One man followed this by a 4½", then a 6", obtained good results from all, and has used nothing but these refractors for the past several years.

SILVERING isn't extinct, by any means, even though aluminizing today seems superior. From C. S. Walton, 5975 W. 44th Ave., Wheatridge, Colo., we recently received word that a method of silvering described in *The Philosophical Magazine* (London), December, 1938, pages 953-970, had been successful in his hands and that he believed it had advantages over the more familiar method. On the basis of its origins, also of Walton's praises, we asked him to describe it, which he does as follows.

"My attention was directed to an article on silvering, in *The Philosophical Magazine*, December, 1938, written by B. Dasannacharya and Amar Chand Seth, of the Hindu University, Benares, India, which seemed to offer improvements over the familiar Brashear method. Trial met with success, so I pass the method and my experiences along.

"Clean and prepare the mirrors according to the methods stated in 'ATM.'

"Prepare two sets of solutions based on 1 gram of silver nitrate in 2½ oz. water, ½ gram potassium hydroxide in 1 oz. water, and 6 cc. regular sugar reducing solution for each 175 square centimeters of area,

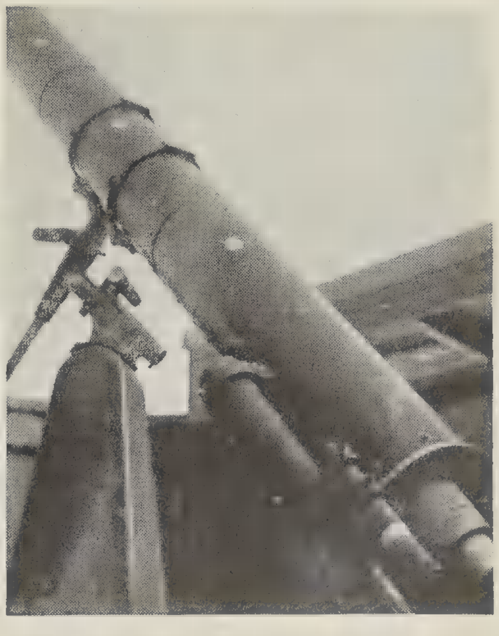


Figure 2: The anonymous refractor

including a dish, if any. An 8" mirror, for example, having 314 sq cm. of area, with a band around it, would be silvered by preparing two solutions, each made of 2 grams silver nitrate in 5 oz. of water, 1 gram potassium hydroxide in 2 oz. water, and 12 cc. reducing solution. The water happens to be an amount that will cover an 8" mirror properly. The two gentlemen of Benares state that the concentration is not important, but that the relation of silver nitrate to area is. They found one gram to 525 sq. cm. to be the best, but with prolonged depositing time I did not get a sufficiently heavy coat and preferred one gram to 175 to 200 sq. cm. Other chemicals are, of course, always maintained in the usual ratio to the silver nitrate. Two applications on the basis described will produce a heavy coat.

"Clear the silver nitrate solutions with ammonia, as usual; add potassium hydroxide solution *slowly*, stirring constantly; clear again with ammonia, very carefully. The solutions clear decisively and there will be no turbidity, sediment or black suspended matter left. They therefore need no filtering.

"Forget the reserve nitrate solution and the instructions to have silver in excess. The authors state that the worker should just clear with ammonia each time, and that, in the second clearing, a slight ammonia excess (a drop or two) may be desirable since the coats will be more free from spots and action will be retarded to a convenient rate. Further, they say that temperature is of little importance. I can subscribe to the workability of all this.

"The solution on the mirror, to which reducing solution has previously been added, will turn clear brown, then opaque black, then gray, and finally, if left on 10 or 15 minutes, will clear to some extent, and will not form a lot of black muck as it does when using the more familiar methods. Pouring off solutions about the time they turn gray seems to be the dividing line between a bright surface and too much white bloom. The wet coat may be washed with mild soap and water to remove bloom and sediment—with reasonable care, of course.

"While I use two applications, I do not deliberately strive for as thick a coat as results, because thin coats seem brighter and have less bloom, and after five years' experience with various coats on a 10½" and 12" mirrors, plus a lot of use of the 20" Alvan Clark refractor at Chamberlain Observatory, entirely on faint variables and novae which frequently were beyond reach of even the 20", I have concluded that something is wrong with the dictum, 'a thick coat is better in every way'. However, double coats produce fewer pinholes for me, which soothes my feelings. Moderately thin coats and thick coats reach about the same minimum star magnitudes in my reflectors, and their performance is exactly proportionate to the 20" refractor in that respect.

"In sum, I consider that the improvements in silvering made in India not only save chemicals, but that the process works clean and precise as compared with the one described in the Bureau of Standards circular quoted in 'ATM'."

FOR the alt-azimuth mounting a wrinkle usually attributed to the Earl of Crawford, and described by S. L. Walkden, of

London, provides a fairly good rough working substitute for the drive clock used on equatorial mountings. Figure 3 is self-explanatory. Walkden writes: "The scheme can be made to work pretty well for looking southward within about four or five hours of

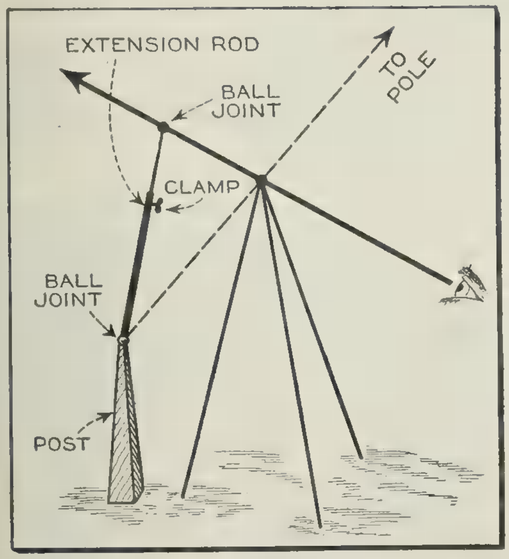


Figure 3: **An old alt-azimuth kink**

the meridian and up to about 60° North Declination. It generally works suitably enough for about an hour's observation. If the eye end of the telescope is slightly overweighted, a cord may be substituted for the extension rod."

IN "ATMA" Everest describes the use of kerosene in place of water for mirror grinding, since the cooling caused by evaporation of water causes temperature effects well worth taking note of in advanced mirror making. W. A. Mason, 1303 Lakeview Avenue, Lorain, Ohio, says he has tried instead some carbon tetrachloride, also "Prestone" anti-freeze, diluted about 1 to 1, and believes these are better than kerosene—though he states that he has used them on only one mirror, hence does not wish to make this claim dogmatically. He also diluted "Prestone" anti-freeze 1 to 1 with rouge and thought it kept the rouge mixture on the lap better than water, also retarding evaporation. Mason is the author of a chapter in "ATMA" (p. 361).

"Prestone" anti-freeze used in automobile radiators, and known to everybody, has an ethylene glycol base and suffers practically no loss by evaporation. In a 1 to 1 mixture of "Prestone" anti-freeze and water, the evaporation, at ordinary temperatures, would be approximately one half that of water alone.

YOU invited some friends over to spend the evening looking at the stars through your telescope. They came—whereupon everything clouded up. The friends hung around through an awkward two hours, giving you the dog-eye, as if it were your fault, and you felt like a plugged nickel. Then they went home—whereupon all the stars came out.

It hasn't happened to you?

This total depravity of inanimate objects does not catch W. L. Chamberlain, 519 Liberty Street, Meriden, Connecticut, napping. He keeps in reserve a dummy telescope made of cardboard tubing, equipped with indirect lighting and an "eye-piece"—a sort of peep-show—and into this he slips various mounted astronomical pictures, half-tones and drawings from here and there. And he says his friends actually think these look better than the reality!

Well, when you consider that these would be mainly exceptional pictures, corresponding to rare views of the heavens taken with large telescopes; also that most persons who have studied or read no astronomy at all are disappointed when they see the stars through a telescope, because in seeing they see only with their eyes while the amateur astronomer "sees" also with the intellect, then these cut-and-dried pictures probably do look better than reality to your friends, who no doubt would be too polite to say so. Of course, one could show such pictures to the visitor even without a dummy telescope, yet there is just enough of the kid in most of us to fall in readily enough with some such guise, just as we do with scenery at a play. This saves the evening when guests look reproachful.

Chamberlain wasn't, however, the first amateur to try this stunt. Holden's biography of Sir William Herschel contains a letter from Sir William to his daughter Carolina, dated July 1782, in which is revealed how Herschel tried it on King George III and his Queen when they came to look through his telescope (George III became a good amateur astromoner later on, even though as a King we Yankees think he wasn't so hot). "When the evening appeared to be totally unpromising," Herschel wrote, "I proposed an artificial Saturn as an object. I had beforehand prepared this little piece, as I guessed by the appearance of the weather in the afternoon we should have no stars to look at. This being accepted with great pleasure, I had the lamps lighted up, which illuminated the picture of a Saturn cut out in pasteboard at the bottom of the garden wall. The effect was fine, and so natural that the best astronomer might have been deceived. Their royal highnesses and other ladies seemed to be much pleased with the artifice."

CONVENTIONS of amateur astronomers will be held Friday-Sunday, July 5-7, at Buhl Planetarium, Federal and West Ohio Sts., Pittsburgh, Pa., by the Amateur Astronomers Association of Pittsburgh, H. Clinton Kyle, General Chairman; also Saturday, August 10, at Stellafane, near Springfield, Vt., Roy J. Lyon, Secretary. All are welcome to both gatherings.

NEWTELLIAN is the name given by John M. Pierce, 11 Harvard St., Springfield, Vt., to a reflector having a small diagonal just outside the incoming beam of rays, which he has described in one of his hobbygraphs.

ADVANCED optical design sharks will be interested in a 13-page article on "The Design of Wide-aperture Photographic Objectives," by R. Kingslake, of the Eastman Kodak Co., in last January's *Journal of Applied Physics* (175 Fifth Ave., New York). Trends is the main thread in this.

FROM *The Journal of the Royal Astronomical Society of Canada*, 198 College St., Toronto, Ont., can be obtained, for a quarter, a practical booklet on "The Small Observatory and its Design," by Brydon, who contributed to same journal in 1939 an article describing "Two Inexpensive Drives for Small Telescopes," one drive being especially interesting. Same cost.

Conducted by JACOB DESCHIN, A.R.P.S.

Making The Most of Your Vacation Shots

THIS piece may seem to be more appropriate at the end of the vacation months, when we have all gathered what vacation pictures we are going to be able to make this season. However, though it may seem like putting the cart before the horse—discussing print-making before we have shot the negatives—this department would like to submit that many a picture would be much improved if the final print were kept in mind even as one is shooting the original subject.

The illustrations reproduced here are the work of Miss B. S. Shannon, a member of the London Terrace Camera Club (New York) and represent two of a large number of negatives she made during a trip to Mexico, that land of limitless picture opportunities. The sermon that Miss Shannon's pictures suggest for this month is that a single negative may often yield more than one picture, even though a print from the full negative may itself be worthy.

Figure 1

Miss Shannon uses a negative format longer in relation to its width than most amateurs are accustomed to work with; as a result, they cannot be enlarged, without cropping, to the usual 5 by 7, 8 by 10, and 11 by 14-inch formats the standard printing papers call for. One of the best examples in her collection is Figure 1, which depicts two moods in a single scene: the busy market-place in the street and the tranquility and dignity of the church on the hill above. Although the two moods might appear to clash, together they present the characteristic flavor or "mood ensemble" that we have come to associate with Mexico. As it stands, the picture has definite charm and undeniable appeal. It is very well worth while. We like it.

Figure 2

However, the negative does lend itself to dismemberment, as Figures 2 and 3 will illustrate. In Figure 2 the concentration is on the market-place; in Figure 3 the church and sunlit rooftops occupy the full picture.

Not all negatives, of course, are so easily separated into two or more pictures. In many cases it is difficult to get even one good picture out of a negative which has been shot without any sense of composition or appreciation of the fact that a picture must have a point of interest and an arrangement in which the various elements are pleasingly balanced.

Another type of negative in which a certain effect was desired but which fell flat because of one circumstance or another, is shown in Figure 4. The goal of the photographer was to shape the three persons (plus the baby) into some story-telling picture, but things did not work out as desired. The baby probably became upset for some

Figure 3

Figure 4

reason, and the mother and boy had their attention diverted. The only saving feature of the picture is the smiling worker leaning on a shovel. By judicious cropping, an interesting picture was salvaged from an apparent failure.

Despite all precautions you may take and all the care put into the making of a negative, pictures in which persons are included,

Figure 5

and particularly where they are shot candidwise, often will prove disappointing. But do the best you can, always keeping in mind that negatives do not have to be printed just as they are exposed but may frequently be "edited," as our movie colleagues have it, to produce at least one picture from a piece of the negative, even though the larger portion of it may be worthless. Sometimes, too, we are obliged, by reason of the angle of view encompassed by the lens, to include more than we desire. Again we do the best we can and keep in mind that when we come to making the enlargement later we can take what we want and let the rest go.

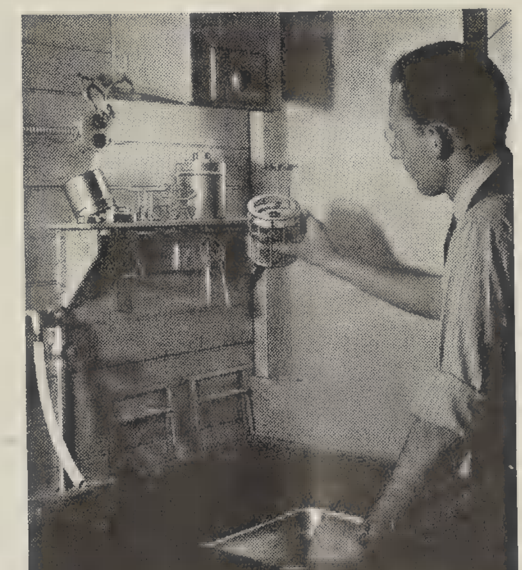
Prepared Solutions *vs* Mixing Your Own

THE question often arises as to whether it is better to buy developing solutions already made up or to mix one's own solutions. Louis H. Lanctot, A. R. P. S., of the Center Photo Stores, Inc. (New York), recently commented on this subject as follows:

"The only advantage of mixing one's own solutions," he said, "is that it is a little cheaper. Sometimes, too, there arises the need for a special formula to do some particular work and having a stock of chemicals on hand makes it very convenient. But on the whole there are good reasons why the photographer should purchase his solutions. The manufacturer mixes the chemicals in large quantities and this reduces any errors in weighing. Again, the mixing operation is carried out in a scientific manner under the supervision of trained chemists and there is no chance for the solution to go wrong. The small additional amount expended on a prepared solution is the price you pay for a chemical engineer to help you, as well as insurance that your solution will work satisfactorily."

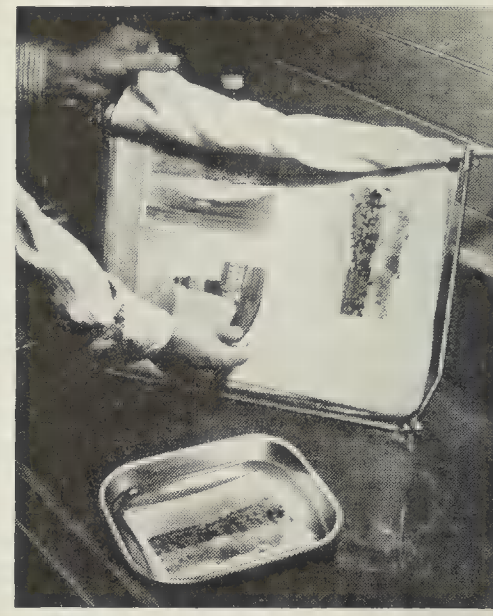
Stainless Equipment in Amateur Darkrooms

THE qualities of stainless steel that have made it indispensable to industry also are responsible for its growing popularity in photography, writes George J. Sherwin, well-known amateur photographer, in a recent communication to this department. Its resistance to chemical action, its cleanness, and its great strength are, in fact, qualities ideally suited to the requirements of photographic work. Profession-



In the darkroom—stainless steel tanks, tray, film driers, and so on

als soon discovered that equipment made of this metal was both convenient and economical, requiring but little care and no replacement. The amateur, as usual, was not far behind the professional. He too clamored for tanks and trays made of the metal that neither tarnishes nor corrodes — that lasts a lifetime. That he knew what



Print washer with stainless frame

he wanted is evident from the great amount of stainless-steel equipment to be found in the average amateur darkroom today.

One of the better known applications of stainless steel to photography can be found in film developing equipment such as the "Nikor" developing tank. The tank probably has to take as much punishment as any other article in the darkroom and therefore must be made of a material that combines many virtues. It must be impervious to the corrosive action of the developer; even if only a slight reaction takes place, fogging or other spoilage of the negative may occur. Then, too, the tank must have a hard, non-porous surface so that it will not retain deposits which, by contaminating the solution, might also cause spoilage. The stainless steel tank, smooth and non-corrosive, fully meets these requirements. Moreover, its great strength is another valuable characteristic.

In addition to fulfilling all these demands of photography, stainless-steel equipment offers other advantages in the way of convenience and economy. Its heat conductivity is favorable because a stainless container tends to keep the liquid in it at a constant temperature, free from rapid fluctuations. It is easy to keep meticulously clean simply by rinsing out. Economy, too, is an angle that the amateur is not likely to overlook. Stainless steel practically lasts forever because of its high tensile strength and corrosion-resisting characteristics.

Many new darkroom accessories of stainless steel are now available. Stirring rods, trays, negative driers, print washers, and thermometers represent only a few of them. One of the most popular is the new type print washer shown in the illustration. It utilizes an entirely different principle which insures both rapid and thorough washing by running fresh water over the prints which are held between its absorbent book-like leaves.

That stainless steel is taking over the American darkroom seems to be an incontestable fact. Some amateurs have even

completely lined their darkroom sinks with it, hiring a local tinsmith to do the job. But for the present, however, most amateurs are content to take advantage of the many conventional items now available.

Re Flat Prints

A CURE for those curling prints most of us keep complaining about is offered by John H. Cornwall. He says it took him all of his 18 years in photography to discover it, but believes he has the solution now. After washing the prints thoroughly, he immerses the prints in the following bath:

Glycerin	12%
Alcohol	5%
Water	83%

He recommends this after-rinse particularly in the case of prints that are to be ferrotyped. Upon drying, the prints fall off the tins flat and without any signs of the corrugations and non-glossy circles that make ferrotyping such a chore and exasperation for some workers.

WHAT'S NEW
In Photographic Equipment

If you are interested in any of the items described below, and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them. Please send a stamped envelope with your request.

KODAK PORTABLE MINIATURE ENLARGER ($42.50 to $60 with lens): Designed for 35mm camera users who lack darkroom or who travel. Packs and dismantles readily in airplane-luggage type case measuring $13\frac{1}{2} \times 13\frac{1}{2} \times 6\frac{1}{2}$ inches. Can be unpacked and set up ready for use in few minutes in any improvised darkroom. Enlargements from $2\frac{1}{2}$ to 9 diameters on baseboard; still greater enlargements by projection to floor or wall. Enlarger head may be rotated 90 degrees to right or left. Scale graduated in degrees indicates angle off vertical. Combines diffuse and condenser illumination by employing No. 113, 50-watt, 115-volt Mazda Photo Enlarger Lamp in conjunction with triple-lens condensing system. Lenses available: Kodak 50mm Projection Anastigmat *f*/6.3 in lens tube, fixed diaphragm; Kodak 2-inch Projection Anastigmat *f*/4.5, adjustable diaphragm stopping down to *f*/22: Kodak Projection Ektar *f*/4.5, adjustable diaphragm and click stops to *f*/22, latter lens designated for color-separation work as well as black and white. Baseboard 13 by 13 inches, takes printing paper up to 8 x 10 inches. Carryall case has three extra compartments, one with hinged cover and cloth lining, providing storage space for additional equipment.

FEDCO BANTAM SPOTLITE ($7.95 less lamp; lamp, 85¢): Miniature type spotlight using 100-watt T8 projector bulb, 115-v. Beam range adjustable from small spot to full flood. Small, compact, lightweight. Made of die-cast aluminum. Completely ventilated. Adjustable handles and knobs of non-heat conducting plastic. Micrometer type focusing. New type 3-inch Fresnel heat-resisting lens. Short focal length of lens permits wide variation of beam width. Op-

erates on 3200 degree Kelvin, making it adaptable to color shots as well as black and white. Chrome-plated, non-tarnishing focusing reflector. Has built-in standard tripod socket. American made.

HAYNES SALON MICRO-MATTE: Enlarging paper with same silver-loaded emulsion as Haynes Salon, but with the coating placed directly on a fine-grain paper base. Designed especially for portraiture and precise rendering of delicate detail.

CHROMO - UNISOL DEVELOPER TONERS ($1.75): Develops and tones prints in one operation. Prints are dried in usual manner, either on ferrotype plates or drum dryer. Choice of sepia, blue, green, and magenta.

PRINCETON PRECISION GLASS FILTERS (85 cents to $1.50): Made from dyed-in-the-mass glass. Said to be "absolutely flat, meaning that there are no bumps or hollows in the surface, not even to 1/1000th part of an inch." Available in following colors: Yellow 1, 2, and 3; Red 1 and 2; Green 1 and 2; Ultra-violet, Orange, and Infra-Red. Sizes 19 to 42mm.

GEM PORSO-GLAZE (25 cents): In white or black. For waterproofing and coating. Used as surface preservative on darkroom trays and tanks and other darkroom items that are prone to rust, chipping, and cracking.

DU PONT SUPERIOR 1, 2, 3: Three new Du-Pont 35mm films. Superior 1 intended for outdoor use. Extremely fine grain; long scale; specially color-sensitized for exposure by daylight. Areas of sky register as printable densities without use of filter. Speed about same as Superior Pan formerly supplied for miniature cameras. Superior 2: twice as fast as Superior 1. For use outdoors in cameras having slower lenses, regardless of weather conditions, and indoors for scenes and portraits with controlled lighting. Color response corrected for incandescent light source. Grain size finer than old type Superior Pan. Superior 3: high-speed film intended primarily for interior use where lighting is not controlled. Color sensitivity takes advantage of tungsten illumination. Grain size about same as former Superior Pan. Forced development increases effective speed of film, making exposures possible at Mazda rating of 100 Weston.

POCKET-PACK BULB KIT: Holds six G. E. Synchropress No. 5 Midget Photoflash bulbs. Made of heavy cardboard about size of ordinary tobacco tin. Bulbs held apart in perforated cardboard belt which slides into heavier protective cardboard sleeve.

SOLAR SLIDING LENS BOARD ($4.75): Mounts three lenses of different focal lengths permitting instant placement of any lens into optical center of enlarger. Sliding unit measures 9¼ by 2¾ inches with ⅝-inch lens clearance at back. Mounts directly to lens board receptacle of enlarger. Will take lenses from 3 to 7¼ inch focal length. Fits all Solar enlargers except Junior Model.

CAMERA ANGLES ROUND TABLE

JACOB DESCHIN, *conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers. If an answer is desired by mail, enclose a stamped, addressed envelope. Queries should be specific, but Mr. Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials.*—The Editor.

***Q.* A certain studio turns out portraits with a bronze tone, which gives the subjects in the portrait a very pretty flesh tone and is subsequently easier to color. Will you please tell me if this tone is achieved by toning? If so, will you please give me a formula and also the type of paper most suitable for this kind of work.—G. G.**

A. The photographer in question undoubtedly uses a gold toner. Agfa Flemish Gold Toner is a prepared product that appears to be generally liked. A good formula is the Nelson Gold Toning Bath (Kodak T-21). A variety of tones may be achieved with these toners and you will have to do some experimenting to obtain exactly the bronze tone you refer to. Chloride or chlorobromide papers, preferably white, may be used.

***Q.* Some months ago I bought a miniature camera with a fast lens. The other day I discovered two small marks about the size of a pin point; they appear to be pits on the front lens. Can you tell me what effect this will have on negatives made by this camera? I have noticed no defects on the ones I have made. I photographed a sheet of newspaper and there was no diffusion in any part of the print. Is such a test of any value?—G. E. A.**

A. The only test of lens performance that is at all useful to the photographic worker is the negative made with it. Therefore, if your negatives look satisfactory, the pits you speak of apparently have no effect and you may continue to use this lens in full confidence. The newspaper test is a very good one because, containing sharp details over the entire surface as it does, defects are easily noticeable. To satisfy yourself completely, we would suggest that you make good sized enlargements from these newspaper negatives and study the resulting prints.

***Q.* Recently I cemented in Canada balsam a tricolor gelatin filter set in 40mm glass circles. The red filter is almost perfect, the green filter is very slightly hazy, and the blue filter turned out to be useless as the diffusion increased to a point where it gives a double image. I have made two sets of these filters with the same gelatin, balsam, and glass and the order of diffusion is remarkably identical. What do you think could be my trouble?—R. M.**

A. The difficulty may lie in one or more of the following factors: the quality of the glass may not be good (it should be plate glass of selected quality); the balsam may not be of a good grade; the cementing or the binding of the gelatin between the glasses may not have been properly done; the bound filter may not have been allowed to dry long enough (it may sometimes take as long as 10 days). If you will check over these various possibilities, you will probably find the answer to your trouble.

***Q.* My camera uses 127 film and I have a developing tank for it which uses eight ounces of solution at a time. 1. Do you know of any developer in concentrated form on the market which is prepared for only eight ounces for tank use? If not, do you know any formula for a developer suitable for tank use, which could easily be prepared for only eight ounces at a time? 2. Approximately how many rolls of 127 films will a quart of acid hypo fix, using D-76 developer and leaving films 15 minutes in hypo? 3. Does the exposure or the developing determine the contrast for the resulting prints? In other words, will each exposure on a roll have a different contrast or will they all have the same contrast?—B. Y.**

A. 1. The smallest volume in which concentrated developer solution is available for fine grain work such as you require is 16 ounces. Panthermic 777 is available in eight ounces but only in dry form. Any developer formula can be scaled down for an eight-ounce solution. It is simply a matter of dividing the larger volume stated in the formula. 2. We do not have the exact figures, but the general attitude of workers is that, since hypo is so very cheap, why not use it liberally to insure proper fixation? On this basis we would say that up to five or six rolls for each eight-ounce volume should be the maximum. 3. Exposure determines the gradation of tone, development time determines the contrast; the longer the development time the greater the contrast, the shorter the period the weaker the contrast. The degree of contrast will be the same throughout the roll.

OUR BOOK CORNER

THE Book Department of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for.

THE SCIENCE OF PSYCHOLOGY

By Raymond H. Wheeler, University of Kansas

PSYCHOLOGY being a word popularly having wide connotation, readers may wish to study the more limited but more substantial part of this total connotation which is recognized as psychology in university courses. A readable work, whether regarded as a textbook or otherwise. (436 pages, 5½ by 8½ inches, 78 illustrations.) — $2.85 postpaid. — *A. G. I.*

FEARSOME CRITTERS

By Henry H. Tryon

"AMERICA," says the author's preface, "has grown so rapidly that much true folk-lore was born, lived, and died with no chance of ever becoming a part of our permanent records." But what visitor to our backwoods, what hunter or angler visiting our hinterlands hasn't heard of "The Side-Hill Gouger," "The Hodag," "The Filla-ma-loo Bird," "The Axe-Handle Hound," and many, many others while resting weary limbs beside the evening fire? Here they are, the legends of America, mostly fabricated by husky hewers of pine forests from shrouds of early morning river mists, back in the days when America was young. A thoroughly delightful compilation of the myths of our woods, fields, and streams. (68 pages, 6 by 9 inches, 31 line drawings.)—$2.10 postpaid.

—*A. D. R., IV.*

EXCURSIONS IN SCIENCE

Edited by Neil B. Reynolds and Ellis L. Manning

TALKS — 36 of them — given on the General Electric Science Forum radio program by different scientists and engineers, ranging from astronomy to physiology and atomic physics to archeology, are set forth in this book in relatively simple language; entertaining and readable. (307 pages, 5½ by 8 inches, unillustrated.) — $2.60 postpaid. — *A. G. I.*

CHEMICAL SPECTROSCOPY

By Wallace R. Brode, Professor of Chemistry, Ohio State University.

READERS of this magazine who have been disappointed by the dearth of good general treatises on chemical spectroscopy should find their want fulfilled by this new work. Compact with information are its chapters on atomic and molecular spectra; emission spectra and apparatus; qualitative analysis; spectrum tables and standard samples; quantitative analysis; resonance and chemical structure; absorption spectra, apparatus and methods; infra-red and Raman spectra; theory and description of color; laboratory experiments; theory and practice of (related) photography; equipment and arrangement of a spectographic laboratory; bibliography and references. The last 120 pages are filled with tables: persistent lines by wavelengths and elements; principal lines by wavelengths and elements (70 pages); spark spectrum of air; principal lines by elements (discharge spectra); Fraunhofer lines in the Sun's spectrum; conversion tables; iron spectrum charts with line positions of other elements. In this book, emphasis is on the practical rather than on theory. It has received flattering reviews in professional journals. (494 pages, 6 by 9 inches, numerous illustrations).—$6.10 postpaid.—*A. G. I.*

AEROSPHERE

Edited by Glenn D. Angle

THIS book presents an up-to-date statement of the main characteristics of the world's aircraft engines, indexed according to nationality. The main characteristics and specifications of almost all well-known engines are presented, with suitable illustrations of each engine. Similar summarized information is presented for airplanes, although in less detailed form. An important section gives records, directories of schools, various governmental bodies, flying statistics, and so on. The last section of the book includes an aircraft directory listing manufacturers of planes, engines, and accessories. The whole constitutes an excellent work of reference with obvious utility for all those having contact with the aircraft industry or wishing to keep up-to-date regarding this industry. (1420 pages.) —$16.00 postpaid.—*A. K.*

PHOTOGRAPHING IN COLOR

By Paul Outerbridge, Jr.

AN acknowledged master of color technique has written a thoroughly practical guide for perplexed color photographers, both rank beginners and those more

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We can supply our readers with any of the books reviewed in this department. Prices quoted include domestic postage. Foreign prices are necessarily higher due to increased shipping charges.

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24 West 40th Street New York, N. Y.

advanced. To the amateur photographer, Mr. Outerbridge is known chiefly through exhibitions of his color work in photographic salons, where his prints always excite the greatest admiration. This book contains the fruits of many years of practical work in the field of color photography, his personal selection of medium being Carbro, and is written in a style that is easy to read, using language that is clearly understandable. One of the most attractive features of the book is the inclusion of 16 full-page, four-color reproductions of his work. The text, which is divided into two parts, discusses the relationship of color to photography, cameras and camera equipment, lighting and exposure, composition and picture material, and the use of color transparencies. The second part of the book is concerned with the laboratory set-up for color work and making separation negatives and full color prints by various processes. (204 pages, 8½ by 12 inches, 16 full color illustrations.)—$4.95 postpaid.—*J. D.*

THE CHEMIST AT WORK

By Roy I. Grady, John W. Chittus, Professors of Chemistry at the College of Wooster, and many others

YOUTHS who think they would like to become chemists wonder just what it would be like to be one—what kind of daily life they would lead. There are many specializing varieties of chemists and in this book about 50 varieties have contributed chapters telling what their work really is like. For example, plant chemists, nutrition chemists, soil chemists, government chemists, chemistry teachers, lubrication chemists, woman chemists, and so on and on in wide variety. A high-school youth, after reading this book, would pretty surely know the answer and not just guess vaguely, perhaps mainly emotionally, at it. Non-technical, of course. (455 pages, 5 by 8 inches, illustrated.)—$3.10 postpaid.—*A. G. I.*

CAMERA, TAKE THE STAND

By Asa S. Herzog and A. J. Ezickson

EXCITING as a detective story, yet factual in content, is this comprehensive running story of the uses to which photography is put by law enforcement officers. In finger-print work, in recording details of the scene of the crime, in identifying firearms and bullets, and in many other ways, photography aids in the work of criminologists. The authors have based their text on actual cases and have used a large number of illustrations taken directly from evidence files. They discuss the means as well as the end product; how the photographic work is done and how the resulting pictures are used. (194 pages, 6¼ by 9¼, a large number of photographs and drawings.)—$3.10 postpaid.—*A. P. P.*

PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE

SIXTH edition of a volume that has become famous in the field of arc welding. There seems to be nothing in that field not covered in detail in this volume of 1117 pages, either in discussions or diagrams, and often both. (6 by 9 inches, several thousand illustrations, limp leatheret.)—$1.50 in U. S. A., $2.00 elsewhere, postpaid. —*F. D. M.*

YOUR FIREARMS and FISHING TACKLE

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; fishing tackle is a requisite of one of the world's oldest occupations. Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department, which welcomes correspondence from readers.*

Gun Collector's Philosophy

SOME men are, by avocation, carpenters, fly-tyers, mechanics, horticulturists, while others delegate such specialized tasks to professionals and invest their leisure in various pursuits. It's all a matter of personal preference, and so it is in gun collecting. The collector, or his agent, may acquire magnificent specimens through contact with legitimate, trustworthy, antique dealers, through museums, or by attending auctions. For these he may pay large or small sums, and more often than not the arms which find honored places in his gun room have been cleaned, reconditioned, and prepared for display.

Not so with Major Lenox R. Lohr, President of National Broadcasting Company. His gun collecting philosophy begins with

Major Lohr . . . and guns

the personal discovery of a specimen, tucked away in some dark cranny of a junk yard, an attic, an old barn, or other casual source, and ends with the investment of a prodigious amount of elbow grease expended in cleaning, refurbishing, and repairing the firearm in an effort to restore it to as near its original status as possible. Somewhere in between these extremes there has occurred a bit of keen, good-natured bargaining which ended in payment of from one to four dollars for the desired specimen, for, says Major Lohr, "Contrary to popular belief, you don't need a wallet-full of money to begin a firearms collection." As proof of the Major's contention, every rifle, revolver, pistol, and shotgun in his collection is in working order, is capable of firing the load originally designed for it, and his largest investment in any single piece has been $4.

Major Lohr's collection of U. S. military rifles, thoroughly reconditioned in his own workshop, has provided him with many hours of pleasant relaxation, knowledge of the details of varied constructions, and the satisfaction of having proved that anyone can pursue the hobby of gun collecting for an insignificant expenditure. In fact, the Major points out, an old gun, purchased for a dollar or two, thoroughly cleaned and repaired, pays dividends on the investment by being of greater value to someone and by increasing the collector's knowledge of the history and mechanics of firearms through the research, study, and effort expended in restoring it. Many an American lad, he says, has earned spending money through harder labor than is involved by subscribing to his philosophy of gun collecting.

Outstanding among the Major's firearms is a group of American military rifles which depict the evolution of the breech loader. Included are: a Springfield muzzle loader of 1837, converted from a flintlock; an 1840 North gun with rising breech for separate loading of powder and ball; a Burnside rifle for separate ball and powder, with percussion cap and tapered breech seal; a Starr rifle of 1858, built for paper cartridge, the end of which had to be bitten off to expose powder to percussion cap; an 1859 Sharp's rifle, with percussion cap equipped with clipper to cut the end of the paper cartridge; an 1861 Ballard rifle, for rim fire fixed cartridges; a Spencer breech loading repeater of 1865.

Are Fish Color-Blind?

IT'S an old but ever new discussion as to whether fish are color blind, yet Dr. Frank A. Brown, Jr., assistant professor of zoology at Northwestern University, recently conducted a series of experiments which would appear to have settled this antique argument. It seems the good Doctor caught some bass in an Illinois lake, put them in large, white enameled basins, and proceeded to feed them with pipettes, or common medicine droppers, which had been covered with adhesive tape tinted in various colors. The joke was on the fish, however, for from one pipette only did they obtain food. All others were electrically wired so that the bass received a mild shock as he nosed into it.

But now came the convincing part of the demonstration. Different fish were trained to obtain food from different colored pipettes. When the bass had completed their "training period," the experiment began. A deliberate attempt was made to confuse the "trained" bass by offering them pipettes in new and unfamiliar colors, and various tints and shades of the colors to which they had become accustomed, but it didn't work. Dr. Brown's bass were unerringly able to select the pipette from which they had been taught to expect food, even to picking out the "soup's-on" pipette from a confusing series of grays. Red, it seems, is the most

distinct color a bass sees, followed by green, yellow, black, blue, with black and blue appearing more nearly similar than any other colors. Despite the results of Dr. Brown's experiments, there will be many anglers who insist fish cannot distinguish colors and that the use of multi-colored lures is merely an attempt to beguile the fisherman, not fish. What do you think?

Duck Stamps for 1940

THE 1940 "Duck Stamp," which must be purchased for $1 by all migratory waterfowl hunters over 16 years of age, will be available to the public at all 1st and 2nd class post offices July 1. This year's design, by Francis L. Jaques, shows a brace of black ducks flying down wind over a marsh area, with wild rice in the background. The Bureau of Biological Survey receives 90 percent of the money from Duck Stamp sales to supplement other funds for purchase and maintenance of waterfowl refuges, and the remaining 10 percent is used for printing and distributing stamps, administrative purposes of the Migratory Bird Hunting Stamp Act, and for other Federal activities relative to migratory bird conservation.

Technology in Rod Making

LAST month we delved briefly into rod making, mentioning some of the early artisans who were pioneers in the six-strip construction so largely in vogue today. With 12 million American anglers wetting lines in streams, lakes, and oceans, however, some of the former handwork on rods must now be done by machinery in order to meet the tremendous demand. By no means should this be construed to indicate that the niceties of skilled workmanship have been lost through technological advances.

To the contrary, at the South Bend Bait Company factory, for example, specially designed machines, so true in operation that variations of .001 of an inch are unknown, convert the split sections of bamboo into perfect triangles. By a gradual taper from one end to the other, which later governs the action of the finished rod, it is possible to produce segments which not only are minutely uniform, but which pass micrometric inspection. Some conception of the exactitude of this machinery may be gained by realization that in some rods 12 pieces of cane are used instead of six, thereby producing a rod within a rod. Likewise, the South Bend Bait Company constructs what is known as a "Triplebuilt" rod from 18 laminated segments of cane, and even goes further to produce their Cross "Bow Stave" big game fishing rod, shaped from more than 40 flat strips of outside bamboo enamel, laminated and glued under pressure.

But the important point to remember is that these sections, or "sticks" as they are known to the tackle trade, must remain in seasoning vaults at least 1½ to 2 years before they are finally fashioned into a rod. Only after this seasoning period can such hand operations as straightening, cleaning, balancing be done. Each section must be finished to pre-determined calibrations, checked every 2½ inches on the circumference of the rod. Is it any easier now to understand why a fine rod cannot be turned out in a day?

Pot-Shots
AT THINGS NEW

FOX, SAVAGE, AND STEVENS 1940 catalogs are off the press and each presents an array of guns to delight the hand and eye of the most critical and fastidious gunner. They're all there, from the ever-reliable little Stevens .22 single-shot to the Fox FE Grade, double-barrel shotgun in all its breath-taking beauty and symmetry. To mention but a few innovations incorporated in the 1940 products, Fox Model B, made in 12, 16, and 20 gages last season, is also available this year in .410 bore, chambered

Savage . . . Fox . . . Stevens

for 3-inch shells in 26-inch barrels. This light-weight, popular priced, hammerless double met such enthusiastic acceptance when brought out last year that additional barrel lengths may now be had. The 16- and 20-gage guns come with 26- and 28-inch tubes, while the 12-gager may be obtained with 20-inch barrels.

In the Savage line, new rifle for 1940 is Model 602, similar in design to the "3-way" Model 6, except it is chambered for .22 shorts only. As an automatic, it will handle .22 short regular or hi-speed cartridges with lubricated bullets; as bolt action repeater or as single shot, it takes any .22 short cartridges. The 99-H Carbine, with 22-inch barrel, is now chambered for the .300 Savage cartridge, as well as for the .250-3000, .30-30 and .303, but with 20-inch barrel for last three. Model 99-RS is now regularly equipped with Redfield No. 70 adjustable rear peep sight, folding leaf middle and gold bead front sight, has ⅞-inch combination adjustable leather sling and carrying strap with quick release swivels. Model 40 Super-Sporter has checkered, capped, full pistol grip, checkered fore-end. Models 23-AA, 23-B, C, and D come equipped with ⅞-inch sling loops, are likewise checkered on grip and fore-end. In automatic shotguns, Models 720-P, 726-P, and 740-P have as standard equipment new Aero-Dyne Super Poly Choke built integral with barrel and Bev-L-Blok front sight.

Model 762 is Stevens' new 1940 offering. Comparable in design to popular Model 76, which handles .22 L.R. cartridge, the new gun is also automatic, but is chambered for .22 shorts. The No. 620 repeating scattergun in 12, 16, and 20 gages has been redesigned to eliminate upper tang from frame and to provide streamlined frame and stock, which now has full capped, checkered pistol grip. Same gun, but known as 620-P, comes with new Aero-Dyne Super Poly Choke built integral with barrel. Stevens .22 caliber repeaters and automatics are drilled and tapped for Weaver 'scope sights, eliminating factory fitting process. Public reaction to use of the plastic, Tenite, on Model 530-M shotgun for stock and fore-end has been so satisfactory that No. 22-410, over-and-

under combination rifle and shotgun will be similarly equipped later this year. We discussed use of Tenite in December, 1939, issue (Vol. 161, No. 6) and have severely tested our own Tenite-stocked Model 530-M. It not only "shoots sweet," but also can "stand the gaff." The Fox-Savage-Stevens parade of guns is on, and catalogs are available. Which will you have?

American Optical Company offers relief to fishermen from dazzling sun by filtering out reflected glare rays through their new AO Polaroid Day Glasses, which help to locate fish before they locate you. With better vision and ability to see the big ones strike, it's easier to set the hook. Skeet shooters, too, should find AO Polaroid glasses of great benefit.

From Inquiries we've had, there must have been something very alluring about Smith & Wesson's new .22 cal. target re-

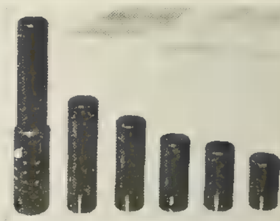
volver, "Model K-22 Masterpiece." Here's a picture which will prove it has "oomph"; we still have a few K-22 folders.

Mohawk Products Company has borrowed a leaf from Galileo and developed a telescopic peep sight as an improvement over standard peep disks on receiver and tang sights. Combining two precision ground plano-convex lenses, one of flint, the other of crown glass, Mohawk has achieved a telescopic effect with a field which is bright and free from the blur often found to some degree in peep disk use. Total length of Peep 'Scope at normal focus is just under one inch; thread diameter of shank is 7/32 with 40 thread, or .218-40, which fits all standard peep disk holes except Marble, but which does fit the Marble-Goss. Diameter of object lens is 8mm and that of ocular lens is 4mm. Width of field varies according to distance which 'scope is mounted from eye. Based on a 100-yard range, with 'scope four inches from eye, field is about 12 feet, increasing until, with 'scope two inches from eye, field is about 25 feet. C. B. Mitchell, of Mohawk Products, tells us that every lens is rigidly tested and that with normal eyes, or fairly well corrected eyes, and with 'scope set at full magnification on distant object, newsprint can be easily read at 24 inches with same focus. "This," he says, "means the front sight shows up very clearly, while distant objects are twice as plain as with the unaided eye."

W. R. Weaver Company, makers of 'scope sights for target and hunting rifles, as well as that Weaver IX shotgun 'scope of benefit to so many scattergun shooters, announces their new Weaver-Choke, developed to (1) eliminate "blown" patterns; (2) reduce recoil; (3) adapt one gun to 20 to 70 yard shooting. Choke has series of baffles in bore to catch and divert through numerous vents gases which are released before shot leaves gun muzzle, thereby reducing pressure on shot column and minimizing muzzle blast. This, in turn, cuts down disturbance to shot, which, directed by the choke, continues forward, resulting in even and uniform patterns. Reduction of recoil is also accomplished through baffle rings and gas vents. High velocity powder gases strike baffles, giving forward thrust, which reduces recoil.

Weaver-Choke is made of strong aluminum alloy, weighs no more than section of barrel removed, won't change handling or balance of gun, is finished with special process which gives bore a diamond-like

A group of Weaver-Chokes. Tallest one is full choke in baffle tube

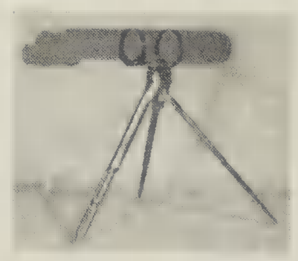


hardness and perfect surface for passage of shot. The six chokes, which may be changed in a few seconds, were designed as to length, shape, taper, constriction after exhaustive tests for following individual purposes:

Extra Full Choke—extremely close patterns averaging 85 percent for long range shooting, even to ducks at 70 yards, if shooter does his part. Full Choke—shoots about 75 percent, or same as standard, full-choke gun. For ducks to 60 yards, long shots at doves, desert quail to 50 yards. ¾ Choke—small game at 40 to possible 45 yards. For ducks from blind, western quail, Bobwhite, rabbits. ½ Choke—fairly wide shot spread; dependable small game killing to 35 yards. Bobwhite, rabbits, doves, and all shooting where range is not extreme. ¼ Choke—wide pattern for wooded, brushy country where shooting is fast, close, and range not over 30 yards. Skeet or scatter—designed expressly for skeet with wide, even pattern and full coverage on 30-inch circle at 20 yards. For single ball or slug loads.

Weaver-Choke is now ready in 12 gage; available in other gages in July; is adaptable to all autoloading, pump, and single barrel shotguns, either plain or ribbed; can be attached by any good gunsmith or at Weaver factory.

Scope Pointer Company offers new 1½-pound aluminum alloy folding tripod, with machine parts of steel and brass, guaranteed to support 75 pounds. Scope remains attached to cradle, which is fastened to tripod by large, single thumbscrew; may be instantly set to any angle of offset; is controlled rapidly, accurately at ground level



Scope pointer tripod, showing the cradle that holds the scope, and rear leg with controls

by two revolving drums, integral with rear leg of tripod. Rotation of upper drum directs horizontal adjustment, while lower drum swings scope vertically. Legs are adjustable to any angle, have 12-inch spread at ground level, allow more elbow room in prone position. Compactness when folded, centralization of controls, adaptability to any type optical equipment are additional appeals.

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

Affirmation

THE decision establishing a radically new principle for computing profits in suits for copyright infringement discussed on this page under the heading of "Apportionment" in the January, 1940, issue of Scientific American has been affirmed by the United States Supreme Court. In affirming the decision the Supreme Court held that in computing an award of profits against an infringer of a copyright there may be an apportionment so as to give to the owner of the copyright only that part of the profits found to be attributable to the use of the copyrighted material.

The copyright statute provides that an infringer of a copyright shall be liable to pay to the copyright proprietor such damages as the copyright proprietor may have suffered or "all the profits which the infringer shall have made from such infringement." Prior to the present decision the courts have generally construed this provision of the law as entitling the copyright proprietor to recover from the infringer all of the profits resulting from the sale or production of an infringing work even though some of the profits might properly be attributable to factors other than copyright infringement.

In the present case the Court found that a motion picture produced by the defendant infringed a copyrighted play owned by the plaintiff. The total profits realized by the infringer were found to be a little more than half a million dollars. The infringer introduced the testimony of experts showing that the plot and story contributed in but a small measure to the production and success of the motion picture The experts testified that the main factors in producing the large profits were the popular actors, the artistic scenery, and the expert producers and directors. This testimony was apparently not rebutted by the copyright proprietor and accordingly was accepted by the Court as indicating the approximate contributions made to the success of the moving picture by the copyrighted material on the one hand and by the infringer on the other hand. As a result the Court awarded only 25 percent of the total profits realized by the infringer to the copyright proprietor.

In reaching its decision the Supreme Court pointed out that it had been the custom for many years in patent infringement suits to apportion the profits in accordance with the approximate proportions resulting from the infringement and from extraneous contributions made by the infringer. The court concluded that there was no reason why the same principle should not also be applied to suits for infringement of a copyright.

The section of the copyright law providing that the infringer shall be liable to pay "all the profits which the infringer shall have made from such infringement" was held to mean that only the profits resulting from the use of the infringing material shall be paid to the proprietor and that profits resulting from extraneous matters were not payable to the copyright proprietor. The Court held that "when such an apportionment has been fairly made, the copyright proprietor receives all the profits which have been gained through the use of the infringing material and that is all that the statute authorizes and equity sanctions."

FTC Injunction

THE Federal Trade Commission for many years has had power to restrain unfair methods of competition in commerce. More recently, the Commission has been given power to restrain unfair or deceptive acts or practices in commerce. In the usual proceedings the Commission issues a complaint against a party who is charged with using unfair methods of competition or unfair or deceptive acts or practices. If, after testimony has been taken, the Commission finds that the party is guilty, it issues an order requiring him to cease and desist the unfair or deceptive acts or practices.

Naturally, considerable time must elapse between the serving of the complaint and issuance of the order to cease and desist because the party complained of must be given an opportunity to file an answer, testimony must be taken, and due consideration must be given to the testimony. In the meantime the party may continue the practices complained of. In certain instances the continuance of the act complained of prior to the issuance of the order will be extremely detrimental to the public interest and under an amendment to the Federal Trade Commission Act the Commission has been given power to apply to a Federal Court for an injunction to restrain the wrongful act.

The ammendment to the law provides that where it appears that it would be in the interest of the public, the Commission, pending the issuance of a Complaint, may apply to a district court of the United States to enjoin the dissemination of any false advertisement and that upon a proper showing a temporary injunction shall be granted without a bond. This is an extraordinary remedy since the party is restrained from committing the acts complained of prior to an adjudication of the issues by the Federal Trade Commission. Naturally it is only resorted to under unusual circumstances where the public interest is involved.

An example of a proceeding under this section of the law is found in a recent case in which an injunction was granted to restrain false advertising in the sale of cosmetics through a puzzle promotional scheme. It was charged by the Commission that a company selling cosmetics initiated its sales by means of a puzzle contest for which a prize of $50 would be paid for a successful solution. When a contestant sent in a solution it was alleged by the commission that he was notified that his entry had passed a preliminary check-up and was before the final judges. If a payment of $3 was submitted by the contestant he was advised that he would receive five dollars worth of cosmetics and if a so-called "promptness prize blank" was returned within a designated time there would be a chance to win a cash prize in the amount of $1250 and an automobile.

The Commission charged that the entire plan was devised for the purpose of selling cosmetics which were of inferior quality for which the purchaser would have no use and which could not be resold without loss. The Commission also charged that the defendant corporation was a reincarnation of a former corporation which promoted the identical sort of sales scheme and which had dissolved in a short time to be succeeded by another corporation, all for the purpose of avoiding the provisions of the federal laws and evading the Federal Trade Commission. Under the circumstances the Commission argued that to protect the public interest it was necessary to enjoin the company at once, prior to the issuance of a complaint. The Court sustained the contention of the Commission and restrained the company from circulating the advertising relating to the sale of cosmetics through a puzzle promotional scheme.

Emancipation

A SUIT charging unfair competition was brought by the author of an outstanding play dealing with the life of Abraham Lincoln against the producer of a moving-picture drama also based on the life of Abraham Lincoln.

The suit in question was unusual in that it did not charge plagiarism or copyright infringement but was based solely on the theory that the author had dispelled the public apathy with regard to the life of Abraham Lincoln and had caused a recrudescence of lively interest in his life and under the circumstances the moving-picture producer should not profit by this renewal of public interest, especially since the producer had previously expressed the belief that the American public had lost interest in Lincoln.

The Court pointed out that historical facts such as the facts dealing with the life of Lincoln were in the public domain and were available to anyone. Since anyone had the right to use and refer to these facts the Court concluded that the production of a motion-picture play based upon the story of Abraham Lincoln's life did not constitute unfair competition.

In reaching its decision the court made the following statement:

"Countless decisions defining unfair competition preclude any favorable consideration for plaintiff's claim. Since the source of their material belongs to public domain, no exclusive right to the use thereof can be acquired even though they were the first to discover its value as a medium to awaken public interest."

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

AUGUST • 1940

Essential to defense against enemy aircraft are "listening posts" of the type shown on our front cover. Set up on mobile trailer units, these ears of the Army are completely flexible, can be turned instantly in any direction to catch the faint hum of aircraft long before they come into visible range. Data thus obtained are relayed to anti-aircraft batteries.—Photo by Robert Yarnall Richie.

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OUR *Point* OF VIEW

IN NEW DRESS

With this issue, Scientific American opens a new period in its 96 years of publication. Starting with a new cover design and modern, easier-to-read typography, we have evolved a new policy of editorial treatment that, we feel sure, will make Scientific American even more valuable to its readers than it has been in the past.

By segregating all editorial material into specific classifications, we are able to present a departmentalized magazine that permits the reader to turn immediately to those sections that hold the greatest interest to him and to find there the cream of the pertinent news. Then, at leisure, he can survey the other sections, knowing that under certain headings he will find specific types of information.

Preview "dummies" of the new Scientific American, sent to hundreds of readers, have been enthusiastically received. We hope that you will be equally pleased with the final and complete result. In any event, the editors will appreciate your expression of opinion, whether it be in the form of a bouquet or a brick-bat.—*O. D. M.*

ANTI-SABOTAGE

Uppermost in the thoughts of millions these days is the current problem of building up our national defenses. Yet in all the billions of words that have been printed on the subject recently, little or no mention has been made of what should be our *first* and most determined step. Too much emphasis cannot be put on the need for an Intelligence Service expanded to the point of superiority, in numbers and brains, over that of any possible future enemy.

We are a heterogeneous nation. Walking the streets past each of us every day are aliens, first generation descendants of aliens, and misguided "old Americans" who live under various delusions. This is not to say that these categories are all inimical to our interests. They aren't; some, indeed, even among the aliens, are better Americans than some sons of pioneers. But the numbers of these and the freedom of speech permitted them in our democracy make it difficult to identify them until after they may have done their mischief. And it must be remembered that "whispering campaigns" of propaganda can be a more serious form of sabotage than destruction of a powder factory or a power plant. Such campaigns have already started in some sections of the country.

Insidious work of foreign agents, with the connivance of residents, is going on under our noses constantly. Nevertheless, we want no vigilantes, no civilian rumor-mongering or tattling on our neighbors. It follows, then, that a vastly superior Intelligence Service should be organized and carefully trained. If this is not done, our national defense program will assuredly suffer all along the line from the work of numerous foreign agents now present in the United States.—*F. D. M.*

A DRY-DOCK NEEDED

A number of things stand out in much of the current talk concerning the need for adequate national defense. One is the fact that we are now building battleships having a tonnage of 45,000 and may eventually go to larger sizes. Another is the fact that New York City, because of its importance as a possible fleet base in time of war, and its excellent transportation facilities, should be equipped in every possible way to render it strategically efficient in case of war.

The shocking truth is that nowhere in the New York area is there a dry-dock capable of caring for our new 45,000-ton battleships. There is none which could take care of our two largest aircraft carriers, the *Saratoga* and *Lexington*. Yet in time of war these ships might be damaged near New York while defending the port. They could not then put in at New York or be towed in for the necessary repairs before going into service again. The New York Navy Yard dry-dock cannot take care of these ships, is 35 years old, and is up the East River behind bridges which might be bombed so as to block the exit completely. Indeed, in time of war, continued operation of this Yard might hang precariously in the balance.

The Port of New York Authority has recently urged the construction of a dry-dock of a size that would take not only our naval vessels but also the larger transatlantic liners. Such a dock might be constructed at Jersey City, Weehawken, Bayonne, or Brooklyn, but certainly should not be up the East River into which bridges might fall after being bombed. To us, a project of this sort seems a vital part of our national defense program. If that program is to be rounded out, the repair facilities afforded by adequate dry-docks in strategic positions are as necessary as the warships which will defend our shores. The service of the fleet will be handicapped if such facilities are not prepared for their use.—*H. T. R.*

HAVE SOME FUN

A playground exclusively for adults has met with great success in a recreational center near New York City. Here is equipment designed after that formerly used for children, but scaled up to meet the demands of grown-ups.

And why shouldn't mature people hop around on pogo sticks, enjoy the thrills of a see-saw, experience the forgotten joys of a sliding board, pump on swings to their hearts' content, all in the privacy of their own playground and free from the prying eyes and competition of youngsters? Psychologists tell us that the way to keep young is to do young things, to forget the cares and worries of workaday life, to be kids again. The flexible minds that conceived the playground referred to have done their share to make this possible in one small part of the world. Other municipalities will do well to copy.—*A. P. P.*

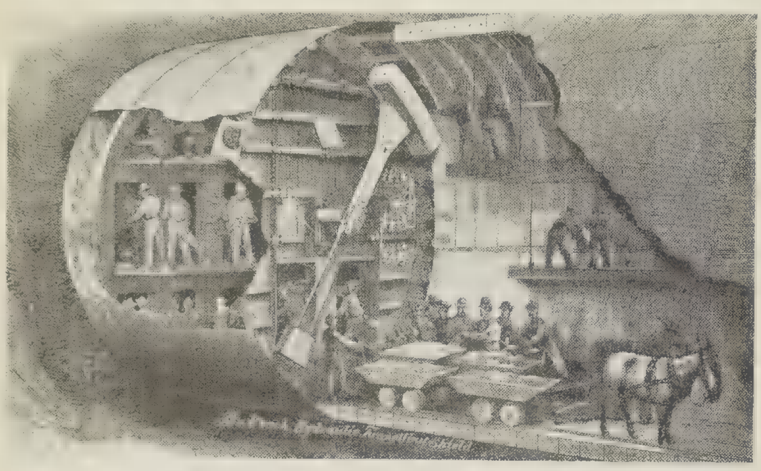
50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of August, 1890)

DEFENSE—"The exposed and comparatively defenseless condition of our most important seaboard cities, in respect to foreign naval attack, has for years been the subject for talk in Congress, but up to the present time little of a practical nature has been done in the line of protection. It is true a few vessels of war have been ordered and some preliminary steps taken toward the manufacture of heavy guns for fortifications. But in regard to the systematic and permanent defense and safety of such important harbors and cities as Portland, Boston, New York, we believe no definite plan has been fixed upon, no material steps as yet taken."

TUNNELING—"A tunnel . . . to extend between Port Huron, Mich., on the American side, and Sarnia, on the Canadian side of the River St. Clair is being bored . . . by means of the Beach hydraulic shields. The walls of the tunnel are constructed of cast iron segments, thirteen of which and a key form the circle . . . The shield is the



invention of Mr. Alfred E. Beach, of the Scientific American . . . It consists of a strong cylinder somewhat resembling a huge barrel with both heads removed. The front end of the cylinder is sharpened, so as to have a cutting edge to enter the earth . . . By means of a system of hydraulic jacks capable of either combined or separate action, it is possible to govern the direction of the tunneling shield with the utmost precision, making it to ascend or descend in the earth, according to grade required, or travel on a curve of any desired radius . . . In the St. Clair tunnel work, each shield is circular, 21 feet 7 inches in diameter, 16 feet long, and is built of plate steel one inch thick."

GOLD TEETH—"American dentists insert in American teeth, each year, the enormous amount of 800 kilogrammes (about 1,800 pounds) of the precious metal, which represents nearly $450,000 . . . It appears that in less than one hundred years the American cemeteries will contain a larger amount of gold than now exists in France."

DEEP—"It has hitherto been supposed that the maximum depth of the Mediterranean was 10,785 feet, between Sicily and Sardinia. Lieutenant Magnachi, of Italy, has found a depth of 13,550 feet, between Malta and Candia."

MILEAGE—"The following is given . . . as the railway mileage at the beginning of 1889: Europe, 133,900; America, 190,000; Asia, 17,800; Africa, 5,200; Australia, 10,500; total, 357,400, as compared with 293,000 in 1884."

INDUSTRY MOVES—"The transfer of industries is one of the most strongly marked and distinctive features in modern industrial life. Its economic causes are to be found in the exhaustion of local supplies, the development of new areas, and the changing centers of commercial distribution . . . The deportation of manufactures from the Eastern States to the West and South will largely change the old centers of wealth and industry. These displacements may entail some local misfortune, and break up some time-honored establishments, but in a general and national sense the distribution of industries is an economic necessity and an industrial blessing."

TRAVEL HAZARDS—"Travelers on the Eastern Bengal Railway have placed before their eyes on entering the stations of the road a placard containing the following cheerful information: 'Passengers are hereby cautioned against taking anything to eat or drink from unknown persons, as there are many who live by poisoning travelers . . . When they reach a place convenient for the purpose, they poison the water or food of the passengers, who become insensible, and then they decamp with all their property.' "

SPEED—"In a recent lecture before a scientific club, Professor Elihu Thomson declared that much higher speeds than can now be obtained with steam locomotives are to be expected by means of electricity, and he considered from 100 to even 150 miles an hour possible. While in the steam locomotive there are reciprocating parts that must be put in motion, stopped, and reversed continually, in the electric locomotive we have simply a rotary motion, which makes it possible to run with economy at much higher rates of speed."

WORDS—"Eighteen words have come into the language —probably temporarily, most of them—to denote the act or state of electric killing. They are as follows: Electromort, thanelectrize, thanatelectrize, thanatelectrisis, electrophon, electricise, electrotony, electrophony, electroctony, electroctasy, electricide, electropoenize, electrothenese, electroed, electrocution, fulmen, voltacuss, and electrostrike."

RABBITS—"A recent report by the United States consul at Sydney, N. S. W., gives a vivid idea of the extent of the [wild] rabbit pest in Australia. The extraordinary fecundity of the animals under the climatic conditions . . . have caused the country to be completely overrun . . . Vast regions are devastated, and the grass and other herbage is devoured . . . The figure of five millions is given as the possible increase of two pairs of rabbits in three years. Yet even this is a low estimate of the possibilities . . . The average life of a rabbit is put at about nine years. The doe may have young eight times in a year, averaging eight each time. The first litter is produced when but four months old. The progressions based on these figures lead to astonishing results."

ELECTRIC HEAT—"Electrically heated flat irons are now made which are very serviceable. The flat iron is of the usual form, but made hollow. The interior contains a lot of coiled wires, through which the electrical current passes and heats the wires hot. The latter are arranged between protecting sheets of mica and asbestos. You turn a switch, and the flat iron at once heats up ready for use."

STEEL CAVALRY OF MODERN WAR

A CHARGE of such modern tank cavalry, though a far less inspiring spectacle than a charge of regular cavalry, has a greater influence on the morale of the attacked. In time, however, the psychological effect is lessened, though their greater "manpower," or striking power per man, is permanent. Judging from present events in Europe, development of the inevitable successful counter to highly mechanized forces is still in the rather distant future. Whether this counter will be some new weapon or simply a sufficient number of opposing tanks, it is too early to say. However, it probably will be found in time.

96TH YEAR SCIENTIFIC AMERICAN AUGUST 1940

MACHINES FOR WAR

Organization and Operation of Mechanized Forces of Our Army

CAPTAIN J. E. McINERNEY
Ordnance Department, U. S. Army

MECHANIZATION, as it refers to war, may be truly defined as the adaptation of the best-known mechanical developments of the existing times to the weapons of war. In recent years, the term has been restricted to the use of automotive vehicles for *combat* purposes. This article will deal with this conception of the term, and will not touch on the subject of motorization which relates to the vehicles of the army that are adopted for general purposes, such as hauling cargo, ammunition, personnel, and equipment, and for towing guns, trailers, and other wheeled equipment.

The development of combat vehicles carrying armament and providing protection for the crew has been a gradual one throughout the ages. History is full of attempts to design devices to permit the soldier to approach the enemy under protection at a reasonably rapid rate and with all the fire-power possible.

Naturally, the greatest advances were made in this type of equipment during the first World War. The conditions of the war in 1916—that is, the use of the machine gun in conjunction with the trench and barbed-wire systems for defense—had so extensively increased the casualties of an attacking force that the war developed into a stalemate. It was impossible to take the offensive without an enormous force and without considerable artillery preparation which eliminated the essentials of the success of the offensive—the elements of surprise and maneuver. The employment of sufficient forces and their necessary equipment to conduct a successful offensive resulted in completely blocking most of the roads in any given sector to the extent of eliminating all freedom of maneuver.

It was soon discovered by the nations involved in the first World War that their resources of manpower were giving out faster than their munitions. To increase their

MILITARY SCIENCE

fire-power and to conserve their supply of men became the goal. It was realized that, with the conditions of the terrain as they existed after two years of war, a wheeled vehicle could not develop the required tactical mobility. Two commercial inventions greatly assisted in solving the problem: a track-laying device and the internal-combustion engine. The track-laying device was first adapted to a combat vehicle, called a tank, in England in 1916. The name "tank" was used to keep the development as secret as possible. With the development of the tank, armed and armored, the offensive was again restored, giving the attacker mobility, protection, and fire-power.

We can get some idea of what our World War leaders thought of the effectiveness of mechanized units from the numbers of tanks which were on order in 1918 for the projected offensives of 1919:

3 ton (Ford)	15,015
6 ton	4,440
Mark I	1,000
Mark VIII (Anglo-U.S.)	1,500
Mark VIII U.S.	1,450
Total	23,405

For our nation, mechanization has many distinct advantages. As the most highly industrialized nation in the world it will give us, as a result of our great production facilities, a superiority which cannot be approached by the non-industrial nations. An army which is mechanized will have on its side the necessary elements of surprise, maneuver, mobility, and fire-power, which are required for a quick and decisive victory. A nation not mechanized will have to fight a losing war or a long, costly, and inconclusive one with the resulting human, industrial, economic, and moral attrition.

It has been natural for us to follow, in a general way, foreign practices concerning the use and development of our mechanized units. However, our geographical and economic conditions are such as to dictate characteristics for our army which might be entirely different from those of most other armies. For example, the military tactics of a given country may have been dominated by the condition of its being hemmed in on all sides by potential enemies, requiring that they have fast mobile units which can be concentrated at any of its many frontiers on short notice. These conditions, therefore, might lead to the neglected development of extra-heavy tanks, and tend toward the adoption of light, fast-moving vehicles.

ANOTHER country, on the other hand, feels that her prime and foremost objective is to prevent an enemy from getting a foothold within her borders. Hers is mainly a defensive attitude, and this is reflected in the type of vehicles which are developed for their mechanized units; that is, a medium tank, heavily armored, of relatively low speeds and no great cruising ranges. This type is not as vulner-

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able to anti-tank weapons as the fast-moving vehicles.

Our problem is more nearly similar to that of a nation having extensive colonies requiring types of light, armored cars which have great cruising ranges and can be used not only in actual combat in a major war, but also in settling domestic troubles throughout the entire domain. When we consider that the theater of operations of the American army might cover the entire American continent it should be realized that our chief requirements are for light, high speed, long-range, cruising vehicles.

Although many foreign nations, were active in developing mechanized units immediately after the war, very little was done in this country until 1925. It is true that we did maintain a number of light and heavy tank organizations equipped with the slow-speed, wartime vehicles. These units were mechanized infantry. In 1925, a board of officers was convened in the War Department, and as a result of its study an experimental mechanized force was assembled at Fort George G. Meade, Maryland, in the summer of 1928. Included in the equipment of this force were four light (7½ ton) tanks capable of a speed of 20 miles an hour, two cargo carriers with the same chassis as the light tanks, and two light and four medium, armored cars. Most of the other equipment had been procured during or after the World War.

THE results obtained with this experimental force were so encouraging that, in 1930, Congress appropriated funds to organize an actual mechanized force at Fort Eustis, Virginia. This force totaled 640 men; and included therein were representatives from every branch of the service.

In 1931, the War Department assigned a mechanized mission to the cavalry and directed that the mechanized force at Fort Eustis be demobilized and formed into a reinforced cavalry regiment. This was in order to permit the cavalry to develop its organization and equipment for the performance of its normal cavalry missions. Thus was born the mechanized cavalry.

There is a definite need for two distinct types of mechanized forces. The first should be highly mobile and capable of rapid advances so as to pass through enemy columns and to make flank or rear attacks.

An American medium tank. It is fast, well armed, and has good armor

These forces must be able to penetrate through thinly defended areas, or exploit a break-through made by the heavier fighting forces of infantry supported by infantry tanks, but cannot, because of their equipment, be required to deal with heavily defended positions. The second type should be equipped in such a way as to break through heavily defended areas. The first missions will be performed by the mechanized cavalry, and the second by the mechanized infantry.

The War Department Directive of 1931 prescribed the mission of the mechanized cavalry as follows: "Mechanized cavalry will be organized to fulfill the normal cavalry role, substituting the vehicle for the horse." This then requires that mechanized cavalry perform the following normal cavalry missions: Offensive combat, long distance strategic reconnaissance, fighting for the theater of reconnaissance, seizing points of strategic importance, tactical reconnaissance, pursuit, delay of hostile advances, exploitation and taking advantage of break or weakened positions in hostile battle line, and attacking enemy rear installations.

This War Department Directive did not in any way envision the complete elimination of horse regiments from our cavalry organization. There are still many conditions, especially in the western hemisphere, under which the cavalry mission can be better accomplished by horse troops than by mechanized units.

As a result of this Directive, the Seventh Cavalry Brigade Mechanized was developed at Fort Knox. It is composed of the following units: 2 regiments of cavalry mechanized, 1 regiment of artillery, 1 brigade headquarters troop, 1 ordnance maintenance company, 1 quartermaster maintenance company, 1 squadron of observation aviation, 1 medical troop, and 1 engineers troop.

It is planned to increase the mobility of the brigade by adding a reconnaissance and support squadron composed of a reconnaissance troop, machine gun troop, and a motorcycle troop. In addition to acting as a brigade reconnaissance unit, this squadron will also serve as a minor reserve and a small arms, fire-support unit.

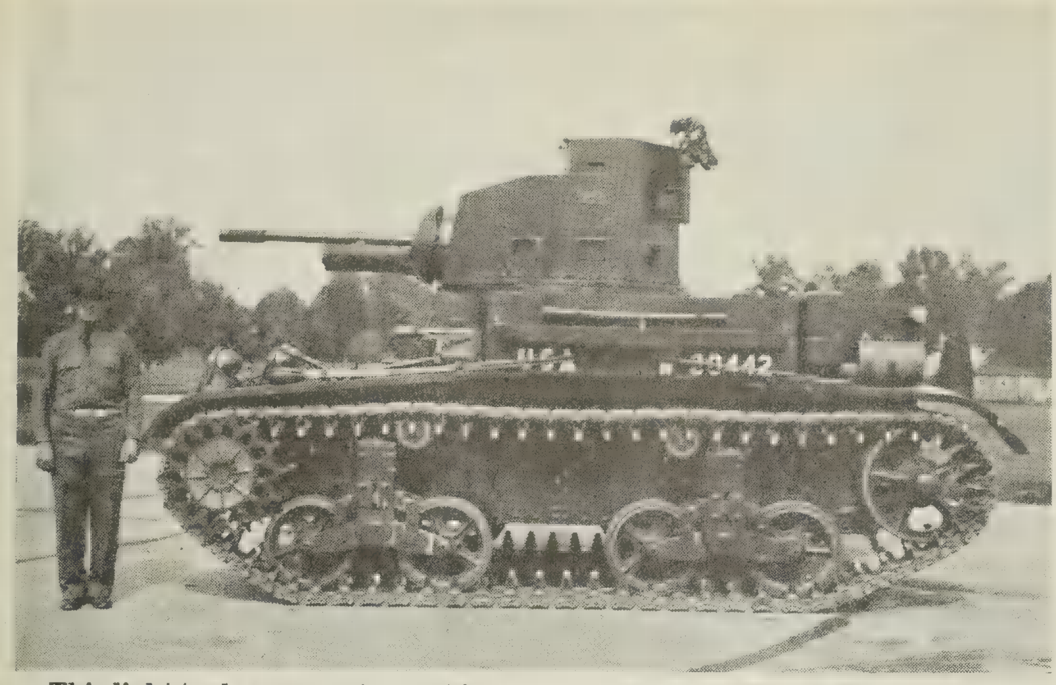
In order to increase the fire power of the mechanized regiment, a third combat car squadron will be added to each regiment. This will increase the number of combat cars in the brigade from 112 to 172.

The cavalry regiment is the smallest organization with the equipment and means necessary to perform the four principal cavalry missions, namely:

a. The reconnaissance troop mounted in scout cars equipped with caliber .50 and caliber .30 machine guns is charged with carrying out the necessary *reconnaissance* mission.

b. The combat car squadron mounted in combat cars with caliber .50 and caliber .30 machine guns and with ample armor plate for protection are capable of exerting vigorous *striking blows.*

c. *Small arms support* is furnished by machine gun troops



This light tank represents great improvement over its World War prototype

in scout cars.

d. A mortar platoon, mounted in vehicles somewhat similar to scout cars, firing smoke shells, provides for the *defense against hostile anti-tank weapons.*

It is interesting to note that our largest mechanized unit is a brigade. Most of the large foreign nations have complete mechanized divisions. The Germans have the panzer division; the French, a light mechanized division; and the British, armored divisions.

The mechanized cavalry will have their greatest opportunity of using their organizations to best advantage in open warfare. However, in cases where the enemy has been able to establish himself temporarily in a strong defensive position, it will be necessary to use mechanized units capable of exerting greater shock than the highly mobile cavalry units. This shock action will be delivered by the mechanized infantry.

The infantry is charged with the principal mission in battle and is essentially the arm of close combat and can, through the employment of its own weapons, act independently of other arms.

In order for the infantry to carry out its mission, it is furnished with tanks which are equipped with the proper armor, armament, and mobility. As a general rule, tanks will function in close co-operation and co-ordination with the foot soldiers, either by preceding or accompanying the assaulting echelons. When operating directly in front of the attacking infantry, tanks are closely followed by the foot soldiers. The visibility from tanks is naturally not the best, and defenders in many cases may be passed over by the attacking tanks. Under the protection of the advancing tanks, the infantry can properly clean up the advance areas and then permit the tanks to penetrate into the rear areas.

However, there will be cases when the defense is so thoroughly organized and equipped with anti-tank weapons that it will be necessary for a wave of heavy, armored and armed, relatively slow-speed tanks to precede the lighter and more mobile tanks. The former tanks are referred to as leading tanks, whereas the lighter tanks are classed as accompanying tanks. Leading tanks may operate in support of infantry regiments, or they may be attached to the regiment. When operating entirely within a regimental zone it is preferable to have leading tanks attached to the regiment.

Accompanying tanks are assigned to divisions and then may be attached separately to different units as small as a battalion. Our tank organizations are made up of tank regiments and separate divisional tank companies. Practically all the divisional companies are part of National Guard organizations, whereas the Regular Army units are tank regiments.

Light and medium tank regiments are practically the same in organization, with the latter having a slightly greater number of personnel. Both are composed of three battalions of three companies each, and the company in turn consists of three platoons. This represents the triangular type organization. Within each regiment there are 162 tanks, of which 135 are combat tanks, and 27 are command and staff tanks.

It is interesting to note that since the war started the French regimental tank organization has disappeared and the tank battalion is now the tactical and administrative unit. Outside of the mechanized division, tank battalions are assigned to GHQ Reserve or to the Army.

As the first requirement in allocating tanks is to furnish sufficient support to overcome any resistance that might be encountered and still have sufficient reserve strength to push on to further objectives, tanks should be used in relatively large numbers. The tank company may operate separately, but the tank platoon never does.

In deciding on the use of tanks, it is essential to give careful consideration to the nature of the terrain. In making a study of this problem, all possible information should be obtained from maps, aerial photographs, and by ground and air reconnaissance. Natural obstacles to tanks are rivers and streams which cannot be forded, marshes, fordable streams with steep banks, thickly wooded areas with large trees, and areas with closely spaced boulders. In open, rolling country, where excellent fields of fire are available to the defenders, the effectiveness of tanks is greatly limited.

SOME idea of the importance of proper reconnaissance may be obtained from the recommendation of Major General Walter C. Short, Commanding General of the Fourth Corps Area in discussing the lessons learned from the Corps exercises at Fort Benning. That recommendation was that a troop of mechanized cavalry be added to each of the streamlined divisions, the troop to have three platoons—one to be assigned to each of the combat teams of artillery and infantry for reconnaissance purposes.

In addition to a study of the terrain to determine the natural obstacles, it is essential that careful measures be taken to determine what obstacles have been set up by the defenders. Anti-tank weapons will be numerous in any case where the defenders have a day or two to become organized. Whether the guns will always be of the caliber to defeat the armor of the tanks might be questioned. As the armor plate of tanks gets heavier, there

will be a requirement for weapons of greater muzzle velocity maintaining the same mobility for the gun, or less mobile guns of larger caliber. The race between armor plate and the gun has been going on for years. In naval history it is believed that the gun has won out. In tank history there are enough different factors that influence the results that we may expect a different answer.

The following extract from an article by Major O. F. Marston in the January-February issue of *Field Artillery Journal* may be of interest. In speaking about anti-tank defense he remarked: "What results have been accomplished? At least the field artillery feels that, where indirect laying is used, covering zones and areas where zone fire is used on assembled tanks or other mechanized vehicles, the problem has been solved. However, where direct laying is employed, even the most optimistic are not agreed that a solution has been found; and the faster the tank moves the fewer there are who are in agreement on a solution to this vital problem. After talking with many officers and men, and after having had considerable experience with the problem for several years, and with the latest equipment now in the hands of our troops, the writer is of the opinion that the problem is far from solution."

There is no commercial demand for the types of vehicles which are required by our combat arms. The requirements of high speed for strategic mobility and for cross-country tactical mobility are such as to require specially designed vehicles. In designing these special-purpose vehicles, it is the policy of the Ordnance Department to use, as much as possible, commercially available units, such as engines, transmissions, and the like. In most of our combat vehicles, the weight and space factors of the power train units are of paramount importance. As much as possible of the total weight of the vehicle should be devoted to armor plate. Also, sufficient space must be provided in the fighting compartment for the efficient servicing of weapons, for the comfort and convenience of the crew, and for carrying ammunition, guns, radios, and other impedimenta.

THE lighter, high-speed, full track-laying vehicle used in our service is over ten tons. In order to get the required performance in our combat vehicles, it is necessary to have a power/weight ratio of not less than 25 horsepower per ton weight of vehicle. Commercially available engines in the automotive industry are not made with horsepower greater than about 165. Rather than design a special engine, which is an exceedingly long and expensive undertaking, the Ordnance Department has adopted commercially available engines from other fields for use in most of our combat vehicles.

Knowing the many advantages of the Diesel engine, such as reduced fire hazard, increased cruising range, absence of radio interference, and so forth, the Ordnance Department has not neglected the development of this type of engine. A number of Diesel engines giving the required performance for our combat vehicles have been procured. This type of engine is particularly well adapted for use in cavalry combat vehicles because of the increased cruising range—is almost double that of gasoline engine vehicles of approximately the same weight.

Of the full track-laying type of combat vehicles, our army is equipped with combat cars, light tanks, and medium tanks. We have experimented with convertible, or two-purpose, types of tanks and combat cars. The convertible type of vehicle is popularly known as the Christie type, named after Mr. J. W. Christie, an inventor who sold a number of experimental vehicles to the War Department.

Ready for action in Army maneuvers: tanks and scout and combat cars of 13th Cavalry Mechanized

In modern warfare, tanks and planes operate in co-ordination

From an engineering point of view, it is almost axiomatic that a convertible vehicle will weigh more than a single-purpose machine of the same performance and characteristics. It may be noted that none of the major powers except Russia have produced convertible tanks.

The light tank used by the infantry and the combat car with which the mechanized cavalry are equipped are similar in many respects. The engine, power transmission system (except the ratio of the final drive), the cooling system, steering and control systems, fuel and oil systems, and the electrical system are common to both. The chief difference is the thickness of the armor and the amount of armament. The combat car used by the cavalry has a requirement for a higher speed and less armor than the tank.

Tanks in the weight class above 12 tons and less than about 35 tons are considered medium tanks. The medium tanks used by our service have ranged in weight from about 15 tons to 20 tons. The French army is equipped with a number of medium tanks of about 35 tons in which are installed 75mm cannon.

Our army has not been furnished any heavy tanks since the World War when the Mark VIII tank, weighing about 40 tons, was developed.

In addition to the full track-laying type of vehicle, there is a demand for half-track and wheeled vehicles. The half-track trucks and cars are part of the equipment of the mechanized cavalry and are used by the artillery attached to the mechanized unit as prime movers for light guns and for hauling ammunition. The wheeled vehicles are scout cars, also used by the mechanized cavalry, for machine gun and reconnaissance troops. The scout cars are four-wheel-drive vehicles equipped with armor and armament and have fairly good cross-country mobility and are capable of speeds on main roads of over 50 miles per hour.

The recent events in the present war have clearly indicated that the old axiom, "Getting there fustest with the mostest men" still applies, but the tempo of all warfare has been greatly accelerated. However, it has also been shown that, "He that has mostest (mechanized vehicles) fustest will get there fastest." The machine has not entirely replaced the man in modern war, but a nation that is not industrially prepared for war is doomed to an uncertain fate, to say the least!

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TANKS

United States Deficient in Combat Vehicles

THE present war in Europe has shown the military effectiveness of large numbers of combat vehicles of several types, but the United States is sadly deficient in this arm of the service. In recent hearings before the Senate Committee on Appropriations, the following figures were given to show the strength of our mechanized forces.

	On hand May 1, 1940	Will be on hand upon completion of program
Light tanks, M2A4	10	734
Medium tanks, M2	18	194
Scout cars	485	1346
Combat cars (Infantry tanks)	114	208

These figures consider only the very latest models. We do have several hundred light tanks of earlier design but it is believed that these would have very little use except in training.

LARGER CRUISERS

New Type, Heavily Armed and Armored, Suggested

IT TAKES from three to five years, depending on urgency, to build one battleship in an American yard. In times of national peril, more effort is expended on construction of a larger number of small warships.

Under construction and planned for the United States Fleet at present are 10 battleships. Only two of these, however—the *Washington* and the *North Carolina*—have been launched, and each of these two will require more than a year to finish. Completion of the others is proportionately far in the future. Due to this situation, coupled with the war in Europe, it has been suggested that the United States build for the Atlantic a number of large cruisers of 20,000 to 28,000 tons. This would be an entirely new type of warship—fast, armed with 11-inch guns, and well armored against air bombs. It is believed that these ships will constitute a more efficient type for operation in coastal waters than our battleships but will be far more powerful than any present cruisers or the oversized, fast destroyers which may be built to support them.

Whether these new ships will be of the size indicated above or something smaller, Chairman Vinson of the House Naval Committee declares that their construction will not disturb the present building program.

Incidentally, that program probably will be greatly enlarged in the near future, perhaps before this issue is published. As we go to press, Congress is considering a plan to increase our Navy by 70 percent, giving us, by great odds, the most powerful navy in the world. If details are made available, we will publish them later.

Achievements in Textiles

Commonplace Fabrics with Superior Characteristics Given by Special Treatments

PHILIP H. SMITH

When it becomes possible to remove shoe polish, inks, fruit juices, and cocktails from delicate silks and cottons by merely dunking them in a glass of water, you've got something. When a fabric so treated is immediately spot free and dry, you have, to be exact, a marvel of chemistry, not to mention a boon to housewives.

Brilliant achievement in the improvement of commonplace textiles has been all but obscured by the more sensational creation of synthetic fibers out of air, coal, and water, or from cow's milk. But there are now on the market cottons, rayons, and silks which repel water and resist spotting. There are fabrics which resist creasing to maintain their freshness for a long period of time, and there are woolens which won't shrink and are distasteful to moths. If fire-retardent finishes are desired on textiles, they can be had, and so can finishes which are unaffected by mildew, a serious problem at all times but especially so in damp climates.

The threat of synthetic competition can hardly be credited with all the progress in textile finishes. Research has been seeking a way to impart these several desirable properties for many years and success is the logical fruit of cumulative effort.

The public is beginning to learn of water-repellency but there is still confusion in some minds as to the difference between repellency and water-proofing. They are quite unlike. The former describes a treatment whereby fibers are rendered proof to water while the fabric remains porous; the latter calls for making the entire fabric surface impervious to water. Water-proofing is a much older art.

There are two common ways to obtain a water-repellent finish. One is to use a soap bath followed by alum or an aluminum salt to deposit an aluminum soap on the fabric. The other is to apply an aluminum or lead soap from an organic solvent. There is a more recent process wherein a wax emulsion in water is applied to a fabric in a single bath. These finishes were used first for outerwear garments, but varied applications have been made, realizing that repellency means freedom from water-spotting, because a water spot is nothing more than a local contraction of fibers which alters light reflection.

By applying water-repellent finishes to hosiery they can be made virtually splash-proof. Dirt is prevented from penetrating the fibers, so that a gentle washing or dusting will remove it. Snag-proof finishes for hosiery are usually wax emulsions which lubricate the surface to resist abrasion, but resin finishes are coming into use.

All of the foregoing processes leave something to be desired because they are impermanent. It is true that they lengthen time between cleanings and so increase fabric life, and repellency can be restored by incorporating products in the cleaning process, but this is troublesome. Today, permanency is a reality.

One manufacturer has developed a process which will survive about 10 cleanings, and he does a mail-order business in reviving repellency for a nominal sum. There is also a single chemical compound available which can be applied in four steps—impregnation, drying, heating, and rinsing—to render cotton, rayon, and silk durably repellent and do almost as good a job with acetate rayons and wool fabrics. The compound must be applied during the finishing process as it requires good equipment, but it is not a resin as one might suppose.

There is practically no limit to the application of this water-repellent product. It is now being applied to sport clothes, shower curtains, and outdoor furniture, often to replace waterproof materials. Because it leaves fabrics porous, it serves very well to treat undergarments, and the fact that it makes pressing less imperative promises its wide use for men's suits. Hence it may have wide application.

The synthetic resins have been seized upon by the textile industry and are being given quite a wide play. One of the first applications to come to the attention of the consumer was the "fused" shirt collar which won't wilt. This now widely used product is made by sandwiching cellulose acetate or other thermoplastic resin between layers of fabric. Resins also are used to prevent slippage of yarn in woven materials so that garments won't lose their shape, to bind colored pigments in printed fabrics, and to give a glazed effect to textile surfaces.

Different types of resins are used to achieve special effects. Thus the methacrylate type can be used to give fabrics a "handle" which resists laundering and dry cleaning. It is also employed as a yarn size for viscose and acetate warps and for filling yarns of crepe fabrics, because it is easily removed and does not encourage bacterial growth as do casein, glues, and gelatine. Vinyl resins were the subject of a recent announcement to the effect that they serve excellently for water-proofing and moth-proofing with all kinds of fabrics, but this development is still young.

Crisp organdy apron that is water-repellent, permanently starchless

Crease-resistance, or crush-proofing as it is sometimes called, is a quality now imparted to cotton, rayon, and linen as an outcome of English experiments with urea-formaldehyde resins. Here the problem to solve was one of getting the resin inside the cellulosic material of the individual fibers, because an outside coating only produces a stiff and brittle cloth. The process requires impregnation of the cloth in a bath of resin components, urea and formaldehyde, with a catalyst, or a lightly condensed mixture, provided the condensation permits complete penetration. The fabric is then passed through a mangle to remove all excess liquid, and dried. After drying, it is heated to a high temperature to bring about polymerization, or the creation of large molecules from small ones. Then such chemicals as have not been rendered insoluble can be removed by washing.

Satin becomes practical for sportswear when treated with water-repelling chemicals, as in this ski-jacket

Urea-formaldehyde resins have the capacity to alter the life and draping qualities of fabrics, to increase the fastness to fugitive colors, and to reduce shrinkage in washing. Rayons treated with them are given greater strength, particularly in the wet state.

The use of resins by the textile industry is still in its infancy, but for that matter, the resin industry has yet to mature. With approximately 150 different resins on the market and more being born by the minute, it requires much research to determine the benefits to be derived from any single one, or to select the best. Application of resins to fabrics increases their cost slightly and the textile industry is loath to add to cloth prices until the public demands certain properties and is willing to pay for them. Furthermore, an industry as old and as highly specialized as the textile industry is slow to adopt the new, but there is enough stirring right now to promise a wide use of resinous products.

During the past two decades a great deal of research went into development of fire-retardent finishes, but, one and all, the products had some practical disadvantage. The latest and most satisfactory process seems to be one employing ammonium sulfamate. It is claimed not to dust off, nor to alter the feel, appearance, and durability of fabrics. It will withstand ordinary dry cleaning, but not laundering.

Research to attack the problem of mildew and moths has been quite successful and both can mean the saving of millions of dollars resulting from cloth destruction. The most satisfactory agent for mildew control has been found to be salicylanilide. Customary practice is to impregnate the cloth with the chemical from an ammoniacal solution, and then dry it. With the evaporation of the ammonia, the insoluble agent is left dispersed throughout the fibers and threads. Among the several chemicals developed for moth-proofing, the best appear to be organic and inorganic compounds of fluorine or chlorine.

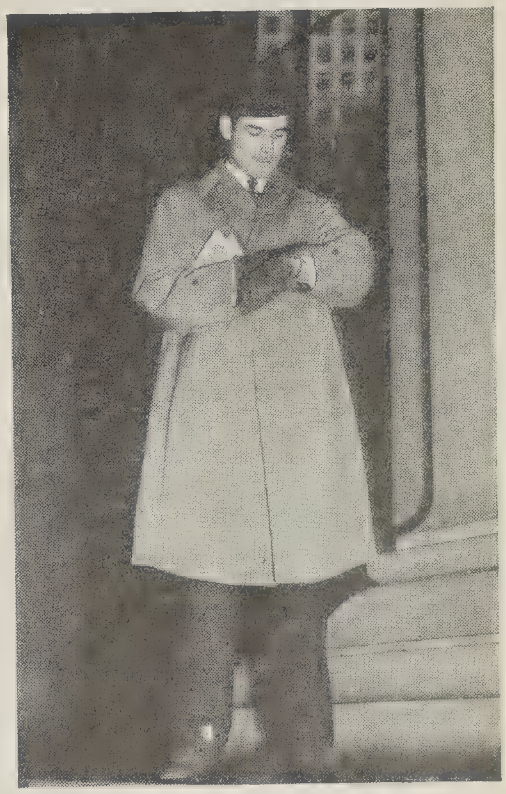
THE conquering of cotton shrinkage is too well known to warrant detailed mention here. It is enough to say that the mechanical process known as Sanforizing gives adequate control over what was once a knotty problem to the textile producer and a terrible nuisance to the consumer. More and more cottons are being pre-shrunk with this process and in time all cottons may be shrunk before sale. Installation of shrinking equipment has been taking place in mills all during the depression to satisfy consumer demand.

The shrinkage of wool has long been studied to devise some means for arresting it to make a more serviceable fiber. A solution to the problem seems to have been reached at last and perhaps the best evidence of success is the statement that all woolen socks distributed to the fighting forces of Britain are to be given the new treatment. Before discussing the process, however, it will help if we outline the phenomenon of shrinking.

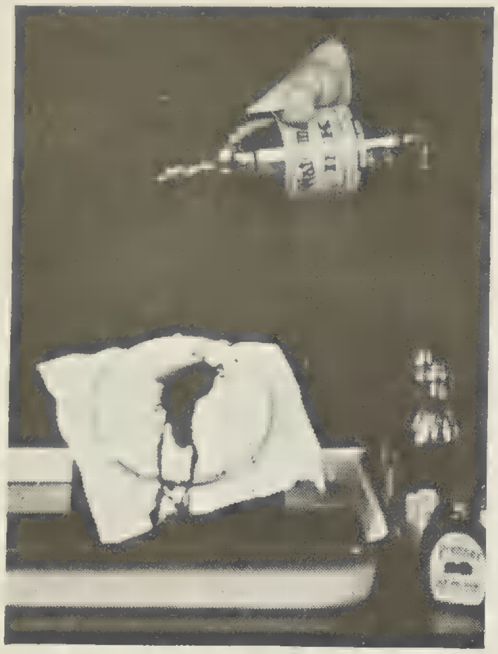
Photos: Du Pont Style News Service

Rayon velvet, made crush-resistant for practical wear

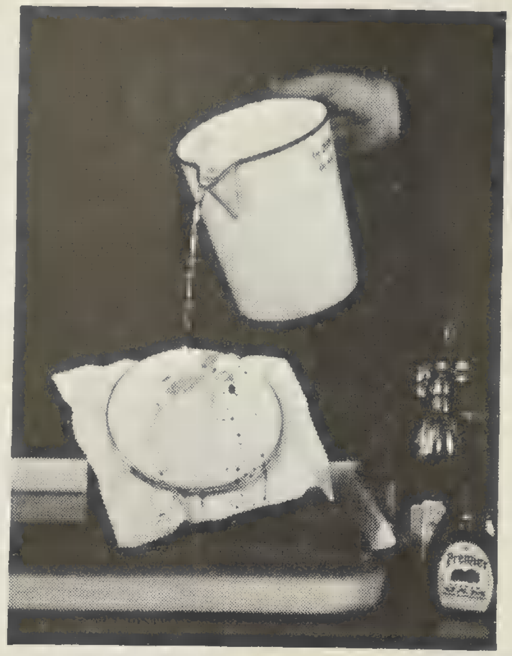
The individual wool fiber appears to be covered with countless small, overlapping scales which are responsible for the interlocking of the fibers, and, incidentally, for the property of felting which is utilized to make felt hats. When wool is compressed in washing, the fibers

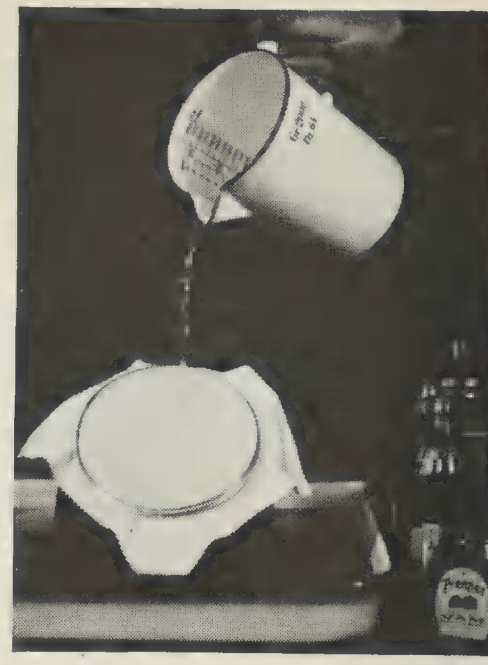


Water-repellency at last makes an improvement in men's coats



Liquids which ordinarily stain are not absorbed by fibers of material which has been made water-repellent. In the tests shown in these photographs, ink was flushed off with clear water





become more and more entangled and close together more tightly, the process being repeated with every washing. Stripping the scales from the fiber will make wool unshrinkable but at the same time it shortens fiber life because they lose their protective covering. If a compromise is sought by removing scales only partially, there is a corresponding loss in shrink-proofing and this falls short of the goal.

The new process calls for applying sulfuryl chloride to the wool with the following claims as to action and benefits: The scales are not substantially removed but rather, their projecting ends are probably made to hold more closely to the fibers so that they are smooth and lose their felting propensities. It is also claimed that the fibers are uninjured.

Other processes developed to retard wool shrinkage are those using dry chlorine gas, and certain of the alkyl hypochlorites. But the claim for these agents is not as strong as those for sulfuryl chloride.

IT IS very evident that research work has been directed toward the improvement of old processes quite as much as to the origination of new ones. Water-repellency and crush-proofing, for example, are not brand new, but older processes were impermanent in effect. Once a fabric had passed into consumers' hands and had undergone its first cleaning, the bloom was off and there was little to warrant paying for so brief a pleasure. The most recent developments contribute a lasting quality value to fabrics and this represents a long stride ahead.

A still further step remains to be taken, however. At the moment, the use of one process pretty much excludes the use of another. The new permanent water-repellency process can be used in conjunction with urea-formaldehyde resins to make a fabric having two imparted qualities, but for the most part processes are mutually exclusive and that limits the number of advantages given to any single fabric.

For just about a century, people have been pondering the idea of printing fabrics in the manner of printing paper so that the color is applied direct, rather than to continue with the laborious process of printing with dyes which emerge as color only after a series of chemical treatments. To get a pigment that will strike into the fabric and make a permanent bond without spreading, that will be lightfast and wash, has eluded searchers for many generations. Such colors are now available—a lacquer type and a resin type. They are incorporated with pigments; and after printing, a drying process develops them. These new types of color are being used to print shirt materials in very large volume and the benefits are primarily those of eliminating developing processes to gain production speed.

There is hardly a phase of the highly specialized process of textile production which has not been touched beneficially by research. Most achievements thus far have small interest to the consumer because the only evidence of benefit is in the overall sense of obtaining better quality and better designed fabrics at somewhat lower cost. But the end is not in sight. Research came to the textile industry much later than to others and what we enjoy now is only a beginning.

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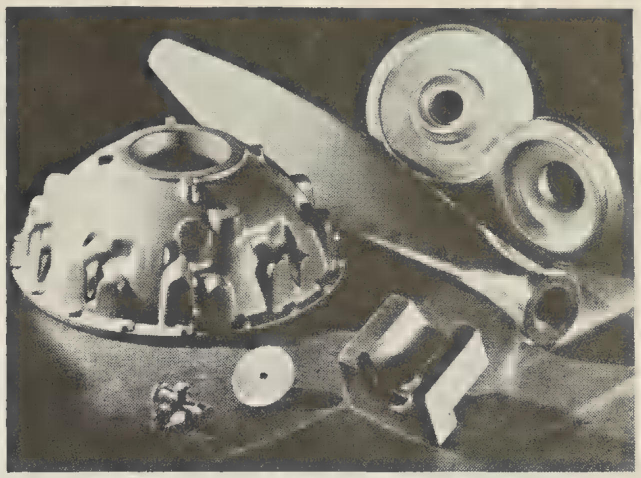
Metal from the Sea

Plant Will Extract Light-Weight Industrial Metal, Magnesium, From Solution

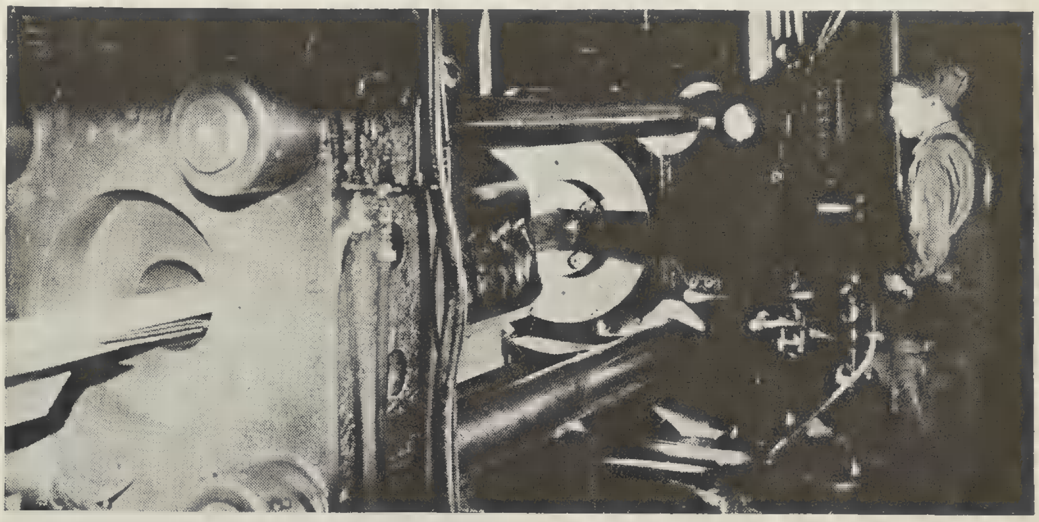
FOR centuries, adventurous men have roamed the seas exploring the hidden depths for the wealth of sunken treasure. Little success has been theirs. Yet long before man even appeared upon the earth the sea was storing up treasures of a different kind—valuable chemicals and metals dissolved from the land by flowing water.

Some years ago a large plant was placed in operation at Wilmington, North Carolina, to extract some of this wealth-in-solution in the form of bromine to be used in preparation of anti-knock gasoline. Now the same company responsible for that plant is building another to extract the metal magnesium from the sea. This new plant, according

At left: Typical sea water intake which will conduct water to settling basins, the first step in production of magnesium from the sea



Below: Extruding an alloy of magnesium. It can also be die cast, sand cast, forged, and welded. At right: Airplane propeller blade and other aviation parts made of Dowmetal, world's lightest, strong structural metal



to a recent announcement by Dr. Willard H. Dow, President of The Dow Chemical Company, sole producers of magnesium metal in America, will be located along the Gulf of Mexico. At that point enough of the metal will be extracted from sea water to raise Dow's total magnesium production from 12,000,000 to over 25,000,000 pounds annually.

The growth of the infant magnesium industry in America has been amazing, considering that it had its birth in 1915—only 25 years ago. For that growth a great share of the credit goes to the founder of the company bearing his name, Dr. Herbert H. Dow.

The growth and development is significant because magnesium, third most abundant engineering metal in the earth's crust, is an important constituent of modern light-weight alloys which are being used more and more widely in aviation, bus, railroad, and general transportation industries as well as in the manufacture of light-weight tools and many other products. The reason for this wide use is that Dowmetal, a silvery alloy, is one quarter the weight of iron, only two thirds as heavy as aluminum, and is possessed of great strength, toughness, and durability. It is speedily fabricated by all common methods.

Each one of the oceans' 320,000,000 cubic miles of water contains something like 175,000,000 tons of chemical combinations of such materials as gold, silver, copper, magnesium, aluminum, calcium, bromine, iodine, and other valuable elements. It has been estimated that these materials in each cubic mile of water have a value of some five billion dollars if only they could be extracted. Bromine *is* being extracted and shortly the recapture of magnesium will begin near Freeport, Texas.

Up to now magnesium has been produced at Midland, Michigan, where the raw materials, from which the metal is extracted, is taken from the ground. Chemists say that it can be recovered from sea water with less effort than from the land because of the fact that the water has already done the preliminary job of washing the magnesium out of the soil.

The new plant will have a capacity of 12,000,000 gallons of sea water daily, yet that plant can operate for 300 years extracting the magnesium in just one cubic mile of ocean water. In that same cubic mile—it is actually more than 1049 billion gallons—there are about 5,700,000 tons of magnesium.

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BOND

Process Binds Rubber to Aluminum

DURA-BOND is a new process developed by Hewitt Rubber Corporation for bonding rubber or neoprene to aluminum, according to the *Aluminum News-Letter*. Adhesive strengths up to 750 pounds per square inch can be obtained, but the process should be restricted to products which operate at temperatures below 200 degrees, Fahrenheit.

This new process makes use of a chemical coating between the rubber and the aluminum which fuses the two materials together without diminishing the ability of the outer layers of rubber to be vulcanized. The metal needs no coating of hard rubber to make the soft rubber take hold, and brass plating of the metal is unnecessary.

Combinations of rubber and aluminum have wide application in the manufacture of sound-proofing equipment for machinery, in the production of spark-proof oil-suction hoses and fittings, and in pickling bath apparatus.

PORCELAIN-LIKE

Coatings Are Hard, Mar-proof, Resistant to Acids, Alkalis

Two new porcelain-like finishes have been developed by Toch Brothers Division of Standard

Varnish Works. Known as Kwickdry and Rockloid, both these finishes are hard and mar-proof, will not chip, flake, or crack. Yet they have remarkable flexibility and light, heat, and chemical resistance. Mild alkalis and acids do not affect them. They are resistant to most solvents and possess excellent humidity resistance.

The first of these two finishes, Kwickdry, is satisfactory for outdoor and indoor use. It may be used as a one coat system or over a primer, sprayed or brushed. It sets tack-free in 10 to 15 minutes and dries hard in one to two hours, or may be force dried at 140 degrees, Fahrenheit, for 20 to 30 minutes.

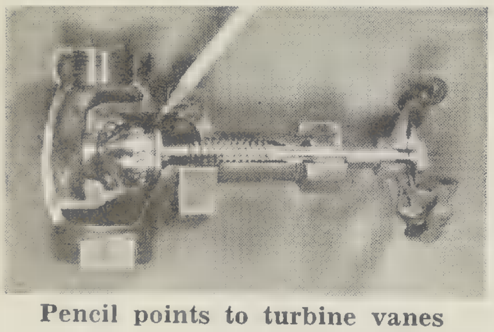
The second, Rockloid, is intended primarily for indoor coatings. It may be applied as a one coat system and baked at 350 degrees, Fahrenheit, for 10 minutes, or at a lower heat for a longer time.

STEAM CONTROL

Spinning Disk Prevents Valve Clogging

A NEW principle of steam control is incorporated in the Ostlind valve, which was announced recently. The valve is the invention of Joel Ostlind. The principle is said to eliminate the causes of leaky valves, rather than to resist them.

The Ostlind innovation is a spinning disk, which rotates up to 2000 revolutions per minute for a moment preceding closing. The disk does not spin when the valve is "cracked," or while throttling. A reversing chamber directs the steam flow to turbine vanes just before the disk descends into the seat. The turbine vanes are shielded from the steam flow when the valve is open.



Pencil points to turbine vanes

The spinning disk throws off scale and other foreign particles by centrifugal force, thereby preventing these particles from becoming caught in the line of seating. The disk hits the seat while spinning at a high rate of speed, and polishes the line of closure, creating a complete metal-to-metal contact between seat and disk, thus preventing "wire-drawing."

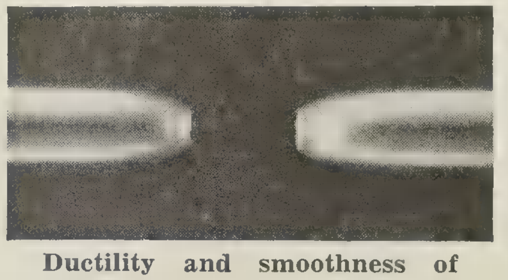
The disk is mounted on the spindle against a stainless-steel ball bearing, aligning the disk with the seat when closing.

BETTER COPPER

Made by Plastic Conversion Under High Pressure

ANNOUNCEMENT of the perfection of a new type of copper after a ten year research and development program costing well into seven figures was made recently by Wylie Brown, President of the Phelps Dodge Copper Products Corporation.

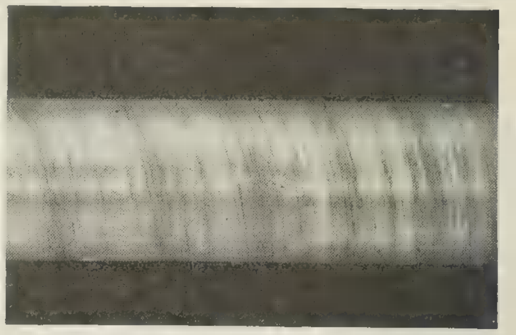
The new copper is known as "PDCP," and was created by research to meet the need of the electrical industry for a copper of superior characteristics. Greater conductivity, ductility, fatigue resistance, and surface quality are the outstanding characteristics of this modernized metal. It is free of the imperfections of ordinary copper, which, according to engineers, have been responsible for a large percentage of electrical failures.



Ductility and smoothness of PDCP shown by rupture test

The improved metal is made, without melting, from electrolytic cathode copper which is plastically converted by tremendous pressure in a reducing atmosphere at elevated temperature, into smooth, dense copper bar, rod, strip, or other desired commercial shapes. Basically of the oxygen-free type, it is the only solid copper in the world which is not melted subsequent to the electrolytic purification process. Hence, the intrinsic purity of electrolytic cathode copper is retained and enhanced.

One of the principal difficulties of engineers and maintenance men concerned with copper windings in motors and transformers, is the existence of surface imperfections in the copper which, by vibration and magnetic stress, eventually penetrates the insulation and causes failure by short circuits. These imperfections may originate in defects arising in the casting process and are normally present in the best commercial copper wire bars. In addition, slivers and oxides are developed during the process of hot-rolling the cast copper bars into rods, and are more or less inherent in the hot-rolling process. The new patented method eliminates not only the casting process, but also hot-rolling. It has, in consequence, made possible the production of a sliverless and dustless copper surface heretofore attainable only in the laboratory.



Twisting rod of new copper to destruction required 30 twists

PDCP copper, in common with all other coppers, is not susceptible to heat-treatment in the sense that the ferrous people use the term: it can be hardened by cold work, softened by annealing. It does, however, anneal at a temperature between 100 and 200 degrees, Fahrenheit, lower than other coppers. In fact, protracted tests have shown that it will anneal slowly in boiling water at 212 degrees, Fahrenheit.

BY-PRODUCTS

Citrus Fruits Find Uses in Industry

A CONSIDERABLE amount of research has been conducted on the problem of finding a use for citrus fruit surpluses and wastes. As a result, many new products have been developed, among which are the wines and liquors announced in these pages some months ago, which were developed by the Bureau of the Department of Agriculture. Also, new and better types of citrus-fruit juices and oils have been developed. These by-products have found a ready market in industry, medicine, and agriculture.

Citrus juices are popular in the beverage and dairy industries. Citric acid from lemons, another best-seller by-product, competes

with Italian imports for use in beverages, lemon and orange oils for bakery goods, candy, and flavoring.

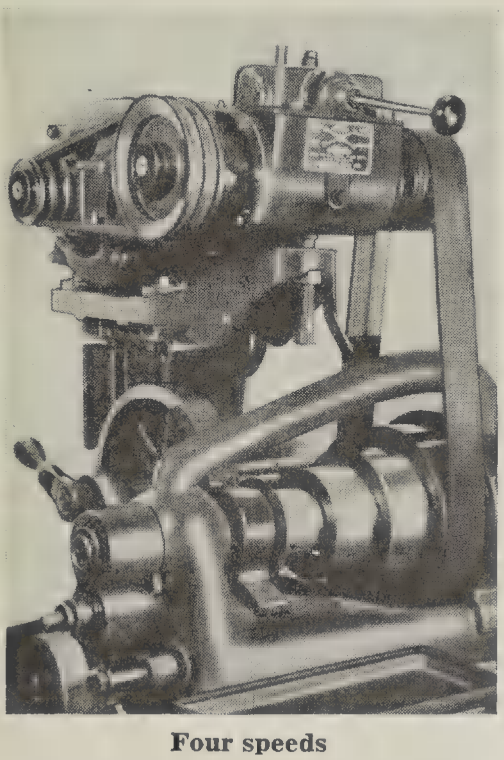
Sodium citrate is used by the dairy industry. Citrus pectin, from the white pulp of citrus fruits, adds creaminess to malted milks and soft drinks. Pectin has been found valuable, too, as a blood coagulant and as a stabilizer for the barium sulfate used in digestive X-ray work and as a detoxication agent. Pectates, close cousin to pectin chemically, have application in paper-treating, in rubber production (for creaming latex), and in quenching steel more cheaply.

Soon to appear is a new vitamin, Vitamin P (citrin), prepared from lemon and orange derivatives, now being submitted for clinical use. "Squeal-of-the-pig" is citrus meal, made from the dried peel and pulp, fed to dairy and beef cattle, poultry, sheep, rabbits, and goats.

MACHINE CLUTCH

For Cone-Driven Machines Makes Speed Change Easy

FOUR-SPEED transmissions for application to cone-driven machine tools are announced by the Western Manufacturing Company. They make changing from one speed to another as easy as when driving an automobile. There are three models—a "Master" for 1 to 5 horsepower, a "Major" for 5 to 10 horsepower, and a "Super" built to specification for machines requiring larger than 10 horsepower motors. It is built for heavy loads with the transmission case and covers of



Four speeds

semi-steel castings and the gears and spline shafts of alloy steel, machined to close limits and ground. All of the moving parts run in an oil bath.

BALANCE

A LOW-PRICED, compact balance, that can be readily dismounted and stored in a laboratory drawer is announced by the Clay-Adams Company. This instrument has been designed to meet the needs of all balance technique, and at a price within the reach of the student in chemistry. It is supplied with brass weights.

In use, the upright beam support is inserted into a metal socket in the box and the beam placed upon it. An eccentric beam release brings the pans to rest. Capacity is 100 grams; sensitivity 5 milligrams; beam, 7.25 inches long with steel knife edge; support for beam is an agate bearing. Pans are 3.25 inches in diameter, and are notched to support test tubes.

SOLDERING

STAINLESS steel, beryllium alloys, brass, copper, bronze, and other metals may be easily soldered when Geko Acid-Free Soldering Compound is used. This is a new product developed by Geko Chemical Company.

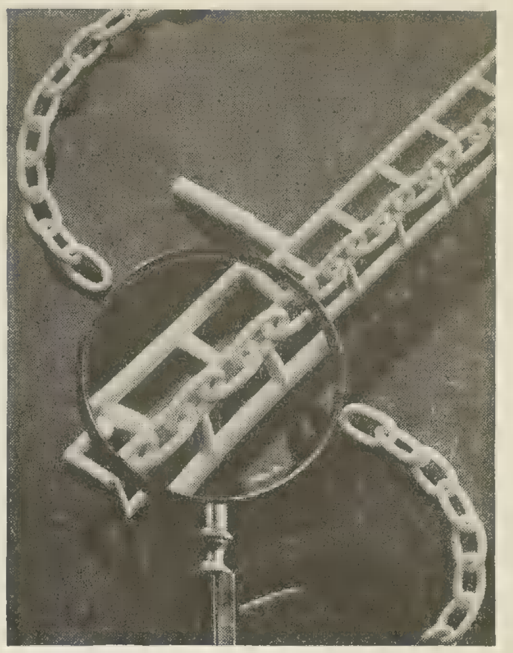
Geko is free of any mineral acid and is therefore non-corrosive if used according to directions. It makes the first cleaning of the metal unnecessary for it creates a perfect and lasting bond even on oxidized surfaces. It may be used with soldering iron, open flame, or even a match, as its melting point is quickly reached.

LINKED PLASTICS

Ingenious Method for Molding Plastic Chains

WELDLESS chains of Tenite are an outstanding accomplishment in the art of plastic molding. They are the first plastic chains of this type, and were made possible by the molding properties of Tenite combined with an ingenious mold design.

The chains are shown in our illustration in both cast and finished forms. The mold design automatically eliminates any cutting, threading, and cementing of the



Chain as cast and as finished

links—operations that are necessary in making the more common welded plastic chains. Severing the links from the runners of the casting is the only finishing required.

AUTOMATIC

Carbon Arc Process Makes Better Weld, Saves Time

AUTOMATIC carbon arc welding is reported to have many advantages in the construction of aluminum tank cars at the American Car and Foundry Company plant at Milton, Pennsylvania. The automatic process permits faster construction and a considerably better quality weld, together with marked freedom from distortion. This development was motivated by a desire to improve quality, not to lower costs which are practically unchanged because the increased flux cost cancels the labor saving.

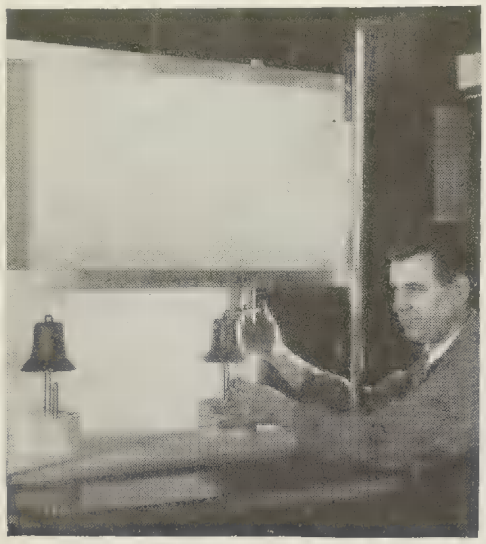
Since no beveling of plate edges is required, the full thickness of metal is utilized in the welding by simply butting the square edges together, greatly simplifying the set-up of the work. The welding time per tank is noticeably shorter than previous methods since the automatic weld is made in two passes instead of the three formerly used. The fact that automatic welding permits welds of complete overlapping penetration accounts for the greatly improved quality of the weld. The aluminum tanks manufactured by the American Car and Foundry Company have, for the most part, been utilized for glacial acetic acid service. This

is the basic material for the manufacture of rayon and non-inflammable film. Two of the aluminum tanks have also been put into service for carrying peroxide. These were constructed of 2-S (99.5 percent aluminum). The remainder of the tanks, for acetic acid service, were constructed of 3-S aluminum (97.5 percent aluminum).

RING

Comparison Tests of Metals Under Heat

A BELL made of ordinary materials gives off a dull thud when struck after being heated to a high temperature. A new metal, called K-



Test by ring

42-B, developed in the Westinghouse Research Laboratories, gives off a brilliant tone under the same circumstances. This new metal is therefore being used for comparison tests of metals.

In our accompanying illustration a bell made of steel is shown at the left while one made of the new metal is at the right, both having been heated to a high temperature. While still very hot, the steel bell at the left gives off a dull thud because of the inelastic movement of its atoms which converts the energy of its vibrations into additional heat.

TESTING WELDS

Magnetic Dust Reveals Tiny Cracks

CRACKS which tend to develop during cooling of a welded joint can be dangerous even though extremely small, since large stresses that are set up in the vicinity of the flaw lead to the extension of the crack in the metal. One of the successful non-destructive means of testing welds for flaws is the magnetic method. Under suitable conditions very fine surface and subsurface flaws as small as 1 by 10^{-5} centimeters can be detected by this method.

The principle of the method depends upon the fact that the presence of a fault in a magnetized specimen will cause distortion of the magnetic field on the surface of the specimen. The magnetic susceptibility of the fault is much lower than that of the sound metal, and the flaw acts as an air-gap, the magnetic flux at this point being diverted into the surrounding material. The leakage field at the flaw can be more strongly detected the nearer the flaw is to the surface. The greatest depth at which flaws can be detected is about 0.5 of an inch.

Best results are obtained with a direct current magnetizing field where the flux passes through the flaw at as near 90 degrees as possible. The type of metal used will determine whether or not the magnetizing current can be turned off while testing the weld. The detection of flaws in the weld is accomplished by means of fine iron dust which is applied to the surface of the magnetized specimen. These particles will then move to a point where there is a large leakage field or a flaw. The dust may either be blown or sifted onto the specimen, or suspended in a suitable light oil which is poured or sprayed onto the specimen. The smoother the surface tested, the more clearly will cracks be shown.—*H. Hirst,* The Commonwealth Engineer *and* Highway Research Abstracts.

CORES

Wetting Agent Reduces Machining of Castings

NON-FERROUS metals can now be cast in smooth, fine cores at a considerable saving in time. This is accomplished by the addition of a small percentage of Sulfatate, a new type of wetting agent manufactured by Glyco Products Company, Inc.

The ordinary core for casting non-ferrous metals is usually a combination of silica, sand-clay binder, and linseed oil. This type of core is very rough and necessitates a great deal of machining to finish the casting. If after baking the core, it is dipped into a solution consisting of one pint of molasses, 10 pounds of graphite, one pound of Sulfatate, and water sufficient to make five gallons, and then re-baked, the core will present a smooth surface, and the casting made from it will require little if any machining.

The addition of the Sulfatate eliminates the necessity of hanging the core so that the excess molasses-graphite mixture will drip off. The core, when it is withdrawn from the solution, breaks cleanly.

CUTTING

Cemented Carbide Tools Now Standardized

PROBABLY every user of cutting tools has looked forward to the time when he could enjoy the many recognized advantages of cemented carbide tools without the necessity of a large investment in special tools. Although the longer service life of cemented carbide tools has proved that they do actually "lower the cost per piece," yet the

Bonded edges of cemented carbide in a standard tool

necessarily higher price of specially-made tools has limited their use on short jobs and general tool room work.

Announcement has been made by the Wesson Company of a complete line of standard carbide cutting tools. At present, these standard cemented carbide tools include reamers, shell reamers, core drills, end mills, counterbores, and inserted blade milling cutters. They are produced by a process which has involved the development of a new treatment for shanks and bodies. An important feature is hardening at temperatures which do not injure the bond or the carbide insert.

INDUSTRIAL TRENDS

FLUORESCENCE

THE New York World's Fair offers a great spectacle of illumination; but, more than that, it has been a proving ground for new and improved lighting equipment. If full advantage were taken of the new light sources available and the general level of illumination were to be raised to adequate heights, lighting would be revolutionized.

Take just one item—the fluorescent lamp. Here is an efficient and practical source of daylight lighting. Invisible ultra-violet energy, produced by an arc, is converted into visible light through the medium of fluorescent powders lining the tubes. Older practice was to coat incandescent bulbs to strain out all unwanted rays, and this was inefficient. The new lamp produces about 40 lumens per watt, the household filament only 15 lumens.

Being unexcelled for color discrimination, the fluorescent lamp is used for matching leaf tobaccos, inspection and pairing of hosiery, and inspection of color proofs. Because powders can be selected to give different colors, progressive merchandisers have a new field for color utilization at their disposal. The lamp radiates only one fourth as much heat as an incandescent lamp, hence it has special value for the food industries and for show-case lighting of perishables.

The fluorescent lamp is a special purpose light, not a substitute. Many units are needed for high levels of illumination, despite the high lumens per watt, because the lamp is a low-wattage type. Equipment and installation costs are higher than for ordinary lighting, but an expanding use is bringing these costs down.

INFRA-RED DRYING

Not to be credited to any Fair is the infra-red drying lamp, now spreading through industry. Upwards of 35,000 of them are used to dry automobile bodies and, having proved their merit in that industry, they are now saving time in the drying of resins, inks, blueprints, paper, and latex. Small portable units have been developed for drying re-decorated wall surfaces and trim in buildings. These units reduce idle time of office space.

The radiant energy near the infra-red region of the spectrum has a peculiar penetrating quality. It goes right through a paint surface to dry it from the inside out. Thus no outer skin forms to retard the process. It works quicker on dark surfaces than light, on rough surfaces faster than smooth ones. No air circulation is required, hence the hazard of dust movement is reduced. Installation costs are relatively low because standard wiring and sockets are used.

RADIANT HEATING

Looks as though the same rays which dry the lacquers on automobile bodies would be harnessed to heat buildings. There are several radiant heating installations in this country, more in Europe, and commercial interests are getting behind it. There is much to recommend it for far wider use in this country.

The principles involved in radiant heating were discussed at length at the time of an earlier push (December 1936, page 335), but here is a brief résumé. Radiant heat is a wave of pure energy which warms objects without heating the intervening air. You feel it when you stand in front of a pot-bellied stove, a fireplace, or in the sun in the wintertime. In the path of these rays, man can be comfortable even though surrounding temperatures are low, because the rays are strong enough to prevent dissipation of bodily heat faster than it can be generated.

Early installations called for pipes imbedded in ceilings. Through these pipes warm water flowed, and the warmed ceilings radiated heat downward to envelop the occupants. A less common installation has metal wall panels heated with water, but this requires four heated surfaces per room. Newest idea is to imbed pipes in the floors. Water, heated to 85 degrees, Fahrenheit, flowing in pipes, is intended to produce a 65-degree room temperature which is adequate for comfort.

Claims for this type of heating are many and well-founded. Installation costs are higher than for convection heating, but there is a saving in fuel, running as high as one third, greater bodily comfort, better control of humidity. Complete concealment of heating apparatus is an added advantage. Offsetting to some degree the higher initial cost due to piping is a possible saving in cost of heating plant. Likewise, need for air-conditioning systems is virtually eliminated.

Apropos of radiant heating is a home-cooling experiment which simply reverses the process. Room walls are covered with two black panels and a layer of aluminum foil. The foil reflects heat to the black panels which absorb it, and both panels and foil are cooled to a temperature of 50 degrees by concealed pipes. A marked reduction in operating cost of air conditioning is claimed for this system.

SHOCKING NEWS

The extreme dislike for electrical shock which live-stock manifest is the cause of some concern among woven wire fence manufacturers.

A single strand of electrically charged wire will keep horses, cattle, and pigs just where you want them. One or two good shocks will condition animals to give the fence a wide berth. Ergo, farmers are favoring the single wire instead of woven wire fence because of the generous cost saving. Actual installation figures are hard to get, but estimates of controller sales give a good indication. Sales have jumped from some 14,000 to 75,000 in four years and the total sales of controller devices, including home-made shocking devices, for this period is put roughly at 335,000. Probably no less than a quarter million miles of electrified fence is in operation.

How much of a headache is this for manufacturers? Not as severe as one might think. There is substitution which has cut into woven fence volume, but much of the electric fence is clear gain. The temporary use for utilizing pastures, making exercise pens, lanes, and after-harvesting gleaning areas, means additional wire sales. Also, the way is opened to fence large areas hitherto prohibitive from the cost standpoint. A rapidly growing use is for protection of existing fences. It will take time to strike a loss and gain tonnage balance. Meanwhile it is a boon to farmers and live-stock raisers.

— *Philip H. Smith*

Maestro of the Atom

Lawrence Had an Inspiration, So Science Now Has the Cyclotron for Smashing Atoms

LORING A. SCHULER

ONE night, 11 years ago, a young associate professor named Ernest Lawrence sat in the University of California Library, plowing through reports of experiments in physics. Mostly they were routine, but one caught his eye.

The experimenter had hitched together two long vacuum tubes, and the speed of the electrified particles had been measurably stepped up as they jumped from one tube to the other. Why, Lawrence thought to himself, only two tubes? If the fellow had hitched up ten, wouldn't he have got the impelling force of a million volts? — enough, perhaps, to smash atoms? But ten tubes in a straight line would be impossibly long. Why not, instead, a circular vacuum chamber, with two half-round shallow copper boxes, shaped like the halves of a pill box cut down through the middle, as electrodes? Oscillating electric current would shift rapidly from one box to the other; a magnet would straddle the chamber, at right angles. If his theory was correct, the same small voltage, used over and over again, would give charged particles a series of electric pushes, while the magnet would keep them going round and round in a compact spiral, something like the spiral on a phonograph record. And thus the hopelessly long device Lawrence had first thought of could be made practicable after all. The particles would go faster and faster, until perhaps they would pile up the speed needed to crack atoms.

That was the birth of the cyclotron, for which the same Ernest Orlando Lawrence has been awarded the great Nobel Prize in physics as the world's number one atom smasher.

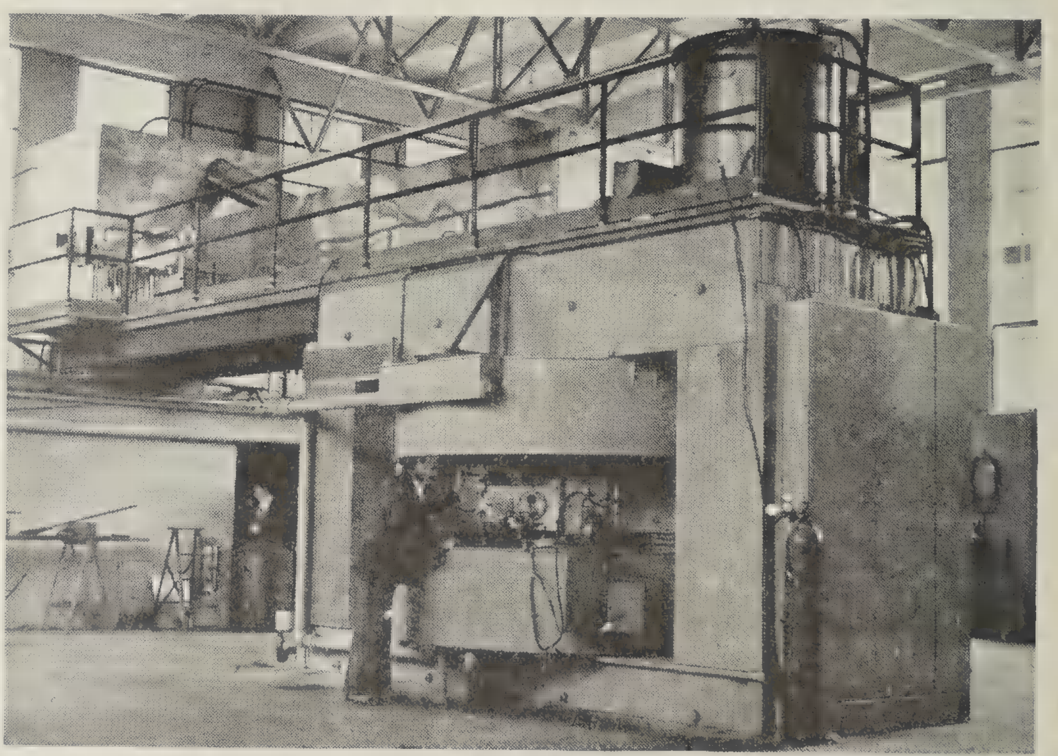
Today, with two huge cyclotrons that he has built at Berkeley — vastly bigger and infinitely more complicated than what he dreamed of that night in the library — he is helping to solve some of the most fundamental and mysterious problems of science.

And, in the unpredictable manner of scientific discovery, what started out to be abstract research is turning out to have such practical value that today medical doctors, chemists, biologists, botanists, entomologists and a great many other scientific gentlemen are all thumbing rides on the cyclotron because it promises to take them to places they have never been able to reach before. A powerful ray is under experimental use as a hopeful weapon against cancer. Artificially irradiated substances, with properties like those of radium, are being created for the study of growth and the treatment of various ailments, while in the field of agriculture plants are being made to tell how they absorb nourishment and make starch and sugar.

These are measurable gains in life and health and wealth. But there is much more, Lawrence knows, to be found beyond the frontiers that he has already explored, so now he is getting ready to build another atom-smasher, 20 times as big as his biggest, with which he confidently expects to be able to reveal Nature's secret source of energy, tap enormous new supplies of power for industry, and transmute the elements by this modern alchemy.

For 25 centuries, men of science believed there was a basic, indivisible particle of matter, the atom, out of which all things were made. Then, only a generation ago, evidence piled up to prove that each atom was like a tiny universe, with a nucleus at the place of the Sun, and electrons whirling round it much as Venus and Earth and Mars and Jupiter and the rest of the planets whirl around the Sun. All the electrons were identical.

FURTHERMORE, it was discovered that there were as many kinds of atoms as there were basic substances — hydrogen and oxygen and sulfur and zinc and tin and copper and silver and gold and radium, and so on to the number of 92 in all, which were called elements. What made each one different from the others in chemical properties was the number of electron planets that each individual atom had spinning round its nucleus sun. Hydrogen, for example, had one electron; oxygen had eight; copper had 29;



The 220-ton cyclotron at the University of California. The big chunky rectangle, with vertical pole-pieces in its middle, is the huge magnet. Between these pole-pieces is the main, "business" part of the apparatus, the circular vacuum chamber containing two electrodes, also the space where projectile particles are speeded up. Power source is on balcony

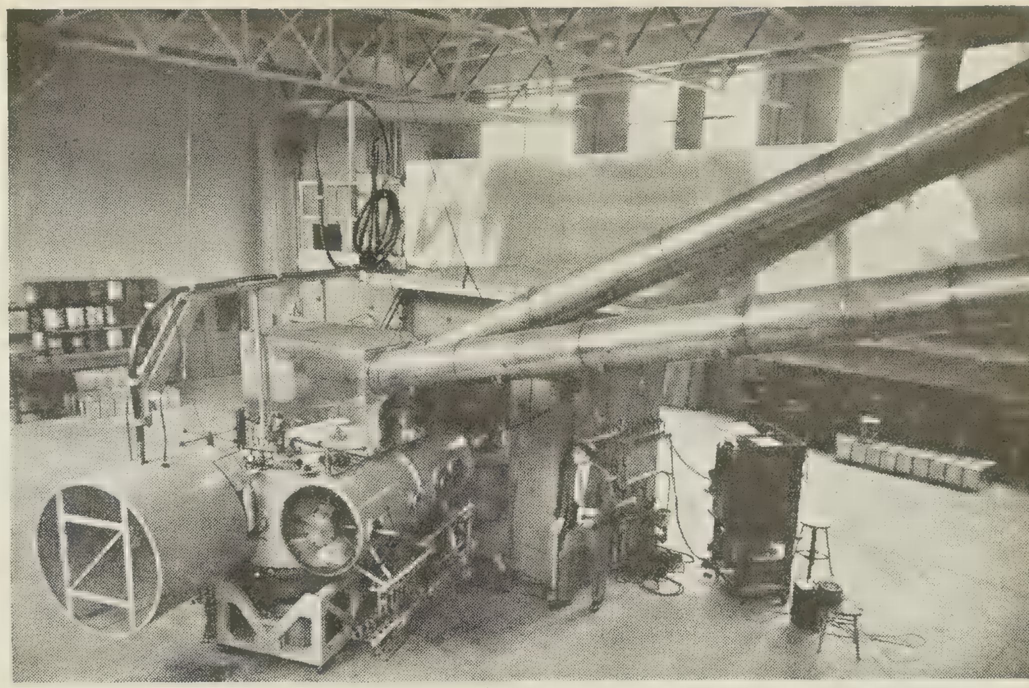
tin had 50; gold had 79; radium had 88, and uranium, heaviest of all, had 92. The elements are known in science by those "atomic numbers."

But strangely enough the electrons, which are charged with negative electricity, could be removed without essentially changing the character of the atom. It would still be an atom of gold or iron, for example. So, the researchers said, there must be something in the nucleus, with its positive electric charge, that we don't know about, and inquisitively they turned experimental guns against the little sun that was the center of each atom universe. Did the nucleus, too, have smaller parts? They found that it did, and named those parts protons and neutrons. And said that here at last were the elemental building blocks out of which everything in the world was made. Meat and potatoes, gold and iron, oil and water — all substances were made of the same protons, neutrons, and electrons, arranged in different patterns. That statement still stands, though Lawrence may find something else when he has built his bigger cyclotron.

But, it may be asked, how did the scientists themselves discover all this about particles which they could not see? Mostly by the painstaking accumulation of evidence. They could take photographs of the tracks of particles in motion, showing streaks like tiny comets; and they could "hear" two particles collide in a vacuum when the effect of their collision was amplified and converted to sound.

It is easy enough to strip the electrons from an atom. The ancients did it, though they didn't know it, in that first electrical experiment of rubbing amber with a piece of cloth. But smashing a nucleus is quite a different matter More than 2,000,000 atoms could lie in a straight line across the dot over the letter *i*. And each nucleus occupies no more space in its atom universe than a fly in a cathedral. The protons and the neutrons are held together by forces of enormous strength. Here is the storehouse of atomic power. To separate the particles, so that the power could be released, would take prodigious energy. That was why Ernest Lawrence, back in 1929, was yearning for a million volts.

Scientists were pretty well agreed that only an atom could be used to smash another atom. If one lot of atoms, they figured, could be made into high-powered, high-



The same cyclotron viewed from the power supply house on the balcony. Nearer cylinder is a vacuum chamber down which particles finally speed

speed bullets and fired at another lot of atoms, those that were hit might be smashed. The problem was how to get the necessary power and speed. A couple of German physicists built an elaborate apparatus to harness the lightning; they might have had something if they could have manufactured thunderstorms at will.

THE virtue of Lawrence's idea was its comparative simplicity. Along in the spring after that night when he made his first sketch in the library, he got around to making a model of the device, exactly following his original specifications. It was only six inches in diameter — a couple of D-shaped shallow copper boxes, mounted between circular pieces of glass and sealed with red sealing wax. But when the air was pumped out and a borrowed magnet was held at right angles to it and the current was turned on, particles actually did spiral round and round at increasing speed. The thing worked.

Later, he built another one, a little bigger, and that worked, too, with even higher velocity. Still, he wasn't smashing any atoms, but he was speeding up electrified particles to greater and greater velocities.

For this he needed a magnet of tremendous size, and, though maggets like that don't grow on trees, he was lucky enough to find one that had been junked in California when the Chinese government failed to pay for a radio broadcasting outfit of which it was a part. It weighed 74 tons.

There were exciting days and nights in the dusty old radiation laboratory at Berkeley while the first working cyclotron was being built. Discouragements when it wouldn't perform according to schedule; cheers when the difficulties were overcome. Parts melted off under the terrific heat that was generated, and were replaced by water-cooled contrivances. Lawrence was everywhere, driving his small crew of helpers, working like a madman himself, taxing even his own great ingenuity to devise ways of getting results without spending money.

But it worked! It really did smash atoms. It did more than Lawrence or anyone else had expected it would. Weirdly, it performed unexpected transmutations. Sodium, with an atomic number of 11, became magnesium, 12, by capturing a neutron out of a heavy-hydrogen nucleus that was shot at it. Aluminum, 13, became phosphorus, 15, by swallowing an electrified particle of helium. Nitrogen, 7, dropped a helium nucleus and became boron, 5, when it was bombarded with neutrons. There were even more complicated changes, and as time went on the laboratory workers found that they could make five different substances out of any element that they put under fire in the cyclotron — they could add or subtract one number or two, producing absolutely different elements, or they could make a variation of the original material.

Other things happened, too. After being bombarded by the cyclotron's fast-flying particles, all the lighter elements, at least, de-

veloped the curious power of throwing off rays, which only radium and its immediate family can do in nature. They were, in scientific terminology, "radioactive."

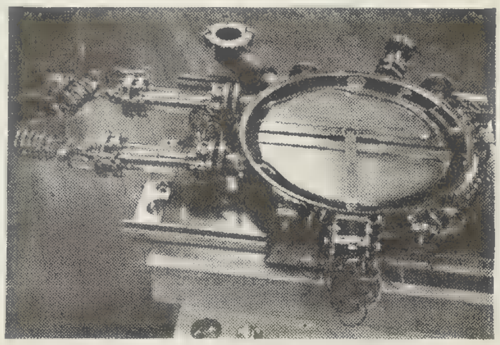
That calls for some explanation, which for the sake of clarity must start with the operation of the machine itself.

Into the very center of the cyclotron, between the two semi-circular hollow copper boxes, is admitted a stream of atoms of hydrogen or heavy-water hydrogen or helium. A tungsten filament ionizes them—that is, strips off the electrons, leaving the nuclei as naked positive charges. They are caught up by the alternating 80,000-volt electric field from the cyclotron's powerhouse. But as they start off in a straight line, the powerful electro-magnet swings them into an arc. Then when they dash across the gap between the two D-shaped boxes, the quickly reversed voltage picks them up and kicks them on again.

A HUNDRED or more times this happens. Round and round the ions spiral in ever-widening circles, picking up speed at each half turn while the voltage reverses some 20,000,000 times a second. It is the principle of the old rope swing—with the original 80,000 volts magnified by each hundred half circles of acceleration to 8,000,000 volts. And by the time they reach the outer edge of the copper boxes the particles are traveling at a speed of 18,000 miles a second, which is 35,000 times faster than a rifle bullet.

At the exit, a target is set up, smeared with sodium or phosphorous or some other element. The speeding ions strike the quiet atoms in the target, and, though the aim is inexact, two quadrillions — 2,000,000,000,000,000 — of bullets every second, concentrating on a target of two square inches, are bound to make some direct hits.

When an atom is "smashed," the protons and neutrons in its nucleus are rearranged. Here, for example, is an atom of boron. A physicist would draw the picture of its nucleus as a circle, with ten little spheres inside, five of them representing protons and five of them neutrons. The atom is hit in the cyclotron by a charged particle of heavy-water hydrogen, known as a deuteron, which may be drawn as a circle containing two little spheres, one a proton and one a neutron. The boron and the deuteron combine. There are now six protons and six neutrons, which make carbon. One substance has been transmuted into another. The new hot carbon throws off one neutron at once, in its effort to regain stability, just as boiling water throws off steam in an effort to get cool. But it still has an excess of energy, and some time later it will throw off still another particle. That is radioactivity.



The vacuum chamber unit removed from the apparatus, with its top off. Inside it are the two semi-circular, D-shaped electrodes, separated by a narrow gap and each supported by a heavily insulated support. Pipe fitting connects with the vacuum pump line. Next to right is the deflector, then one of four casters on which the entire unit may be rolled from between the polepieces of the magnet. Nearer the reader are the window for particle exit and the target holder

Some elements expel these excess particles almost immediately. Others let them stay for a while, and then toss them out, perhaps in a minute or an hour or a matter of years. Nature abhors instability, and each atom tries to regain the stability that it lost when new particles crowded into its family circle.

The cyclotron makes radioactive substances easily, and from many elements. The doctors pounced upon it quickly when that was discovered. Radium is very rare and very costly. It can be dangerous as well as beneficient. The artificial radioactive substances have a shorter active life than radium, which is an advantage because they can be used internally with less danger. And besides they cost a great deal less—a day's bombardment of a common salt produces radioactive salt that for a day or two will do the work of several hundred thousand dollars' worth of radium.

Twenty departments of the University of California are now demanding radioactive products from the cyclotron for their own studies. Biologists are using them to study growth and metabolism. Botanists are having fertilizers irradiated, so that they can find out how growing plants use these "labeled atoms." With radioactive carbon they are learning how plants combine carbon dioxide, water, and sunshine to make starch and sugar. In insect research, sodium is traced through the pests. In industry, radioactive hydrogen is helping to perfect petroleum refining, and radioactive salt can be used instead of radium and X-rays to find defects in battleship armor.

There's more and yet more. Beryllium atoms under bombardment give up neutrons in such great quantities that a healing ray, something like the X-ray or the gamma ray of radium, has become known. The doctors have already used this neutron ray with fair success to halt the wild growth of cancer cells in animals, and some of them believe it offers the most powerful weapon against human cancer that has yet been found.

BECAUSE of the medical value of both the neutron ray and the radioactive substances, a new cyclotron, with a magnet weighing 220 tons, was built on the Berkeley campus last year, and 35 other cyclotrons have been built in other states and other nations.

Lawrence's next cyclotron will be tagged for fundamental research, to unfold the secrets of atomic power and transmutation. Its construction will take three years, and will cost $1,400,000, of which $1,150,000 have already been given by the Rockefeller Foundation. Its magnet will weigh 4900 tons. It will generate 100,000,000 electron volts, perhaps much more. It will be built high in the Berkeley hills, and its operators will huddle in an underground control room, 150 feet away, when the machine is running.

So powerful an engine of atomic disintegration is dangerous as well as useful. Even the present big cyclotron—one twentieth the size of the one to come—is treated with respect by scientists. Five-foot-thick walls of lead and water protect them from flying neutrons.

When the cyclotron is running nothing moves except the atoms whirling in the vacuum chamber, and you couldn't see them even if you were at the heart of the machine. If you should stick your hand into the deuteron beam which is sometimes released as a spec-

tacular stream of bluish-lavender light you would be burned as if you had fooled with a blow torch.

Will industry eventually be able to harness atomic power? There are two ways in which this might conceivably come about. Both have been sufficiently proved to take them out of the class of pure theory; neither is at all near to the stage of practicability now.

The first is energy produced by fission, or splitting, of an atom. Within the past year, atoms of uranium 235, an isotope, or variety, of the heaviest of all elements, have been split by neutron bombardment, which divides them into types of other lighter elements, with the release of immense energies. On paper, the splitting of a uranium atom produces 50,000,000 times the energy release resulting from the burning of an atom of carbon in coal, though researchers quickly reduce this ratio to 17,000 because of scarcity and other factors. The released energy from uranium manifests itself as heat, and if enough could be had steam could be produced to run factories.

The trick will be to bring about what is called "chain reaction," which seems possible because when uranium 235 splits excess neutrons come out, and these, in theory, will attack other atoms and start a chain disintegration with a ceaseless and increasing flow of heat.

So much for theory. On the basis of facts now known, coal isn't likely soon to be supplanted by uranium. Only uranium 235 will split and very little of this has been purified; an increase in consumption would boost the price out of sight; and, last but not least, uranium has a disconcerting high-explosive quality—because of which the Nazis are trying to lay hands on all the uranium they can find.

The other theoretical method of squeezing power from the atom is by annihilation. Two electrons will disintegrate into a wave of energy when they collide. From this, physicists reason that a far greater emission of energy would result if they could make the heavier protons and neutrons kill themselves off in the same way.

Lawrence has written: "A simple calculation according to the relativity theory shows that a glass of water, if completely destroyed and converted into useful energy, would yield more than a billion kilowatt hours, enough energy to supply a city with light and power for quite a time."

The released energy, if it could be produced at will, would be in the form of heat, which could then be used to make steam, to turn generators, to make electricity for the use of industry.

Lawrence also says: "When we can produce atomic projectiles of 100 to 200 million volts, we shall be able to unloose new energy, in light and heat. We shall have new riches perhaps more important than those we have already found. Radium gives off enough energy to raise its own weight of water to boiling temperature every hour, and it continues to do this for thousands of years. There is reason to hope that we shall find the means of releasing the vast store of energy in the nucleus of commoner substances. Indeed, this is more than a hope; it is already a likely possibility."

Co-workers in the laboratory call Lawrence the "Maestro." He is a big man, tall and broad of shoulder; with eyes that are always busy behind his low-set spectacles, and a big, wide, tooth-filled laugh. He plays a good hard game of tennis; has a cruising boat on San Francisco Bay that he won't take out unless there is rough water to make things exciting. Most of all he's curious and generous and honest, sharing each triumph of achievement with associates who love to work with him.

At 38, he is in the top flight of great physicists, and, as one friend wired him on the day the Nobel award was announced: "Dear Ernest, your career is showing promise."

• • •

More About the Cyclotron

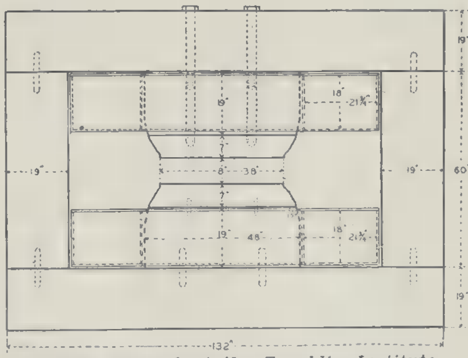
For Readers Who Wish to Look Further into its Technical Details

THE cyclotron is a sort of electrical slingshot for imparting high velocities to sub-atomic particles, in order to crack atoms apart by shooting these projectiles at them.

The accompanying drawings reveal the essential workings of the cyclotron. Inserted between the pole-pieces of the big powerful magnet, but otherwise not connected with it, is the vacuum chamber, shown in one of the photographs of the previous article. The two "D's," so-called by physicists because of their obvious shape, are semi-circular, hollow, shallow boxes, which *are wide open* along their straight facing sides. They do not touch the chamber. As the diagram shows at its left side, they are connected, as capacities, to a radio-frequency oscillator circuit, through an inductance.

To outline the essentials of the cyclotron let us assemble and operate it. First, the cover of the vacuum chamber shown in the photograph in the previous article is replaced and sealed, the chamber is inserted between the poles of the magnet and the interior is exhausted to a high vacuum. Then a small amount of some light gas, like helium or hydrogen, is allowed to enter the chamber. At the center some of its atoms reach a tungsten filament which, like any hot body, gives off electrons. Since this filament is maintained at a negative potential with regard to the chamber, these electrons are pushed off. They collide with the gas molecules and ionize them. These ions are to be the atom-smashing projectiles.

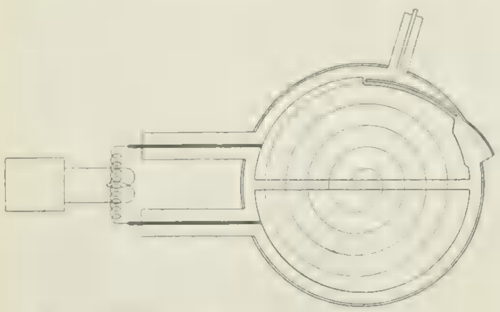
Now to "put the ball in play." One ion, a particle having a positive charge, is assumed to be near the center—about where the spiral starts in the diagram. At this instant in the operation of the high-frequency oscillator the upper D (upper, that is, on the page) has



Courtesy *Journal of the Franklin Institute*

Cyclotron magnet for the Biochemical Research Foundation

attained its maximum negative potential—perhaps 90,000 volts. Therefore the particle is attracted toward it. It does not travel straight toward it but is forced into a curve by the powerful uniform magnetic field passing vertically through the vacuum chamber lying between the pole-pieces. Because the D is hollow and has no wall along its parallel side, the particle does not hit the D. even when it reaches it.



Plan showing main elements of a cyclotron's vacuum chamber

but simply enters its open interior space. This space is practically field-free, but momentum carries the particle ahead and the magnetic field curves it on around. Just as it emerges from the D, the high-frequency oscillator has changed to its opposite phase and the particle therefore is drawn again across the gap, acquiring a doubled velocity as it is attracted.

The rest, for some 100 revolutions, is simply a repetition of the same performances—kick after kick that adds increment after increment of speed ("multiple acceleration") to the particle. Why doesn't it travel in a circle instead of an approximate spiral? Because the radius of its arc after each increase in speed is proportional to the new velocity.

All these things have been taking place actually at the rate of 20,000,000 swift kicks per second. Just as the long-suffering particle has decided that existence for it hereafter must be just one revolution after another, with no hope of ever attaining a permanent, fixed position in life, it has spiralled outward to the edge of the chamber. Here there is a plate charged to a high negative potential, perhaps 70,000 volts. This pulls the particle aside and it dashes through a mica "window," thick enough to exclude the outside air but "mostly hole" for smaller things, and flies at the atoms which it is to crack in the target chamber. This particle has not, however, been alone, for trillions of similar particles have accompanied it on the merry-go-round. How are they aimed at their target? They are not individually aimed at all. It is more like throwing stones at a neighbor's fruit tree in the dark when you were a boy—some of the stones hit some of the fruit.—*A. G. I.*

ELECTRON VOLTS

So Often Seen in Print — So Seldom Interpreted

What does this peculiar term signify? Very loosely, velocity. To most of us, electron volts are a new variety of volts. How can volts mean velocity? Like many other common expressions, this is one that does not mean what it says: any more, for illustration, than F 4.5 or F 8 really means speed in a lens, instead of a ratio that can in turn be interpreted in terms of speed. The amount of kinetic energy acquired by an electron when it has been accelerated through a potential difference of one volt is an electron volt. So electron volts aren't a measure of speed, after all, but of energy. It is, however, one of our mental preferences that we like to think of kinetic energy in terms of something else that we can more easily observe—that is, speed. Should a newspaper reporter correctly state that "two cars met head on, with the liberation of so-and-so many foot pounds of kinetic energy," instead of "two cars met head on at 70 miles an hour," he would lose his job. It is true, nevertheless, that velocity itself never smashed a car or even an atom—the kinetic energy in an object moving at a velocity is what does the smashing.

To convert electron volts into miles per second requires nothing worse than doing a patch of arithmetic the size of one's hand; a complication in the calculations being the fact that the mass of a flying particle increases with its velocity (the "relativity" increase). When the particle attains velocities comparable with that of light its mass becomes considerably greater.

Another question is: "If the particles used in cyclotrons are not electrons but other particles, according to the atom-smashing effects desired by those who operate them, why is the term 'electron' volts used at all?" The electron volt as a unit of energy can be applied to other atomic particles because the charge on any such particle is an integral multiple of the electronic charge. Here are some examples of electron volts translated into terms of speed. An electron in a one-volt field would move at 369 miles a second, a proton at 8.69 miles a second, and a deuteron something over half as fast. These, of course, would be slow, lazy particles. In cyclotrons the speeds read more like scores of thousands of miles a second.

Sometimes confusing is the frequent terminology in sentences like the following: "The atoms of uranium 235 are split, with the release of 175,000,000 electron volts." Again the meaning is, simply, energy. It is easier for the physicists to state it thus than in such terms as horsepower, though this could be done, and it would be as scientific. Conversely, you could, after wrestling with some arithmetic, express the speed of your car in terms of electron volts, but it probably wouldn't impress the judge.—*A. G. I.*

RAMAN EFFECT

Theoretical Discovery Now Has Practical Value

About ten years ago an Indian physicist, Sir C. V. Raman, using refined equipment, discovered that the light scattered by individual molecules is not all of the same frequency as the incident light, but that a minute amount of this scattered light consists of different frequencies. When light strikes a molecule and the electrons interact with it, sometimes a fleeting change is caused in the vibrational state of the electrons. This sudden change causes the "springs" holding the atoms together to jerk and so, part of the time, makes the atoms vibrate. Thus, part of the energy of the incident light is converted into the vibrational energy, so that the light which leaves the molecule has a lower frequency than the incident light.

The differences between the incident frequency and the various scattered frequencies form a pattern, a "Raman spectrum," which is characteristic of the molecule doing the scattering. The appearance of the Raman spectrum of a mixture of different molecules may tell a chemist what molecules are present in the mixture, while the relative intensities of the lines in the spectrum indicate the relative amounts of each. A number of new compounds have been discovered in this way.

BROWSING with the Editor

THROUGH THE SCIENCE LITERATURE OF THE WORLD

WORKER'S WEALTH.—Over half the "wealth" produced in motor plants goes to workers who build the cars.—Automobile Manufacturers Association, 366 Madison Avenue, New York, New York.

GRAPE-FRUIT OIL.—An oil with a nut-like flavor, useful in industry, cooking, and as a salad oil, is now being extracted from grape-fruit seeds—United States Citrus Products Station, Winter Haven, Florida.

FREEZING WATER.—Experiments prove that, contrary to a widespread impression, hot water does not freeze more quickly than cold water.—*Science*, p.384, (April 19, 1940).

CHAMELEON'S TONGUE.—A seven-inch chameleon can capture a fly 12 inches away without moving. His artillery consists of a tongue longer than himself, a lightning-like sticky-tipped weapon which is shot out of the mouth in much the same way a watermelon seed can be shot from between the fingers. Ring-shaped muscles contracting suddenly on a slippery, spike-like bone send the tongue forward.—*Natural History*, (May 1940).

OZONE, NO BACTERICIDE.—Ozone, regardless of where or how it is generated, has little or even no effect on bacteria or germs.—*The Journal of the American Medical Association*, p.1633 (April 27, 1940).

ANT FORTRESS.—A small South American tree, the barrasanta, is a fortress garrisoned by ants. A ferocious species of ants invariably live in its hollow stem and rush furiously out to attack any man or animal that disturbs the tree.—O. L. Haught, Smithsonian Institution.

SULFANILIMIDE.—Experiments have shown that sulfanilimide destroys disease germs by letting them kill themselves with the hydrogen peroxide they themselves create.—*Science Service*, (April 3, 1940).

SMALL OIL PRODUCTION.—"Since the foundation of the oil industry, the entire world's production of crude oil would not fill a hole a cubic mile in the earth."—Dr. Gustav Egloff, *Science*, p.535, (June 7, 1940).

KEEP GAS OUT OF THE EARS.—Rubber ear caps are now being made to protect wearers against certain war gases which, if allowed to penetrate the inner ear, would make decontamination extremely difficult. It is also claimed that . . . they will protect the ear drum from blast. —*India Rubber World*, May 1, 1940.

DANGEROUS AUTOMOBILE DOORS.—Each year about 300 persons in the United States fall to their death through doors of moving passenger automobiles which they open in order to slam them shut. The rush of air swings the door completely open, pulling the person out of the vehicle. —*Statistical Bulletin*, Metropolitan Life Insurance Company, April 1940.

WE'RE NOT SO HUNGRY.—During 1939, the average person consumed something like 100 pounds less food than the average person did in 1900. Today, electricity does work in factories, homes, and farms, which used to make people develop man-sized appetites.—Dr. O. E. Baker, U. S. Department of Agriculture.

NEW INDUSTRIES.—Fifteen million Americans now work at jobs which did not exist in 1900.—Everett S. Lee, General Engineering Laboratory, General Electric Company.

BETTER FREIGHT SERVICE.—Today's freight trains can do more work and do it better and in less time than those of 20 years ago. Freight cars average eight tons more in carrying capacity; locomotives average 43 percent more pulling power; and freight trains go 64 percent faster, on the average.—Association of American Railroads.

TO FIND MORE OIL.—Around 6000 geologists, geophysicists, chemists, paleontologists, and other scientific workers, are said to be engaged nowadays in the search for oil. —Thomas A. Boyd, speaking before The Franklin Institute, April 29, 1940.

FOREST FIRES FROM CARELESSNESS.—Only 10 percent of the forest fires that burn more than 34,000,000 acres every year are due to natural causes, such as lightning. The rest are man-caused.—The American Forestry Association.

RUBBER FROM HOME-OWNED PETROLEUM.—"In 1939, about 1,100,000,000 pounds of natural rubber were used in this country. Over 200,000,000,000 pounds of synthetic rubber could be produced from ethylene from the cracking process."—Dr. Gustav Egloff, *Science*, p.538, (June 7, 1940).

CHEAPER LIGHT BULBS.—In 1900, the cost of electric light bulbs was approximately one cent per candle power of light. In 1939, the cost was less than one sixth as much, and the power consumption less than one fourth as much, per candle power.—Dr. A. W. Hull, General Electric Research Laboratory.

NO SILVER.—There is no silver in nickel-silver. It is an alloy of nickel, copper, and zinc.—*White Metal News Letter*, May, 1940.

DIPHTHERIA DEATHS.—A record of no diphtheria during an entire year has been achieved by 32 cities in the United States.—*Science Service*, May 8, 1940.

TREATING SINUSITIS.—While there are various preparations or treatments that are of temporary palliative value in giving relief from the symptoms of sinusitis in some but not all cases, there is no known home treatment that is a cure or competent remedy for this condition.—National Better Business Bureau, Inc., May 24, 1940.

SAFE RAILROADS.—A person is safer on an American railroad train than in his own home, according to statistics. During the past 10 years, fatalities to passengers in train accidents averaged only one for each 1,498,000,000 miles run.—Association of American Railroads.

NICKEL USE.—Of the 210,194,000 pounds of nickel sold during 1939 by International Nickel, the United States alone consumed 101,200,000 pounds, or nearly half the production of the world''s largest producer.—*White Metal News Letter*, May, 1940.

CIVIL ENGINEERS.—One hundred years ago there were but two main types of engineers: "military" engineers concerned with the operations of warfare, and "civil" engineers engaged with problems of civil life. For a time, all engineering in civil life was called civil engineering, but soon major differentiations developed . . . .—*Engineering Opportunities*, by Dr. Karl T. Compton.

An Ideal Experiment

Taking the Moon's Temperature During an Eclipse Reveals a Phenomenally Big Drop

HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

"COLD moonlight" is poetry and fact in the same phrase. The Moon's light carries so little energy with it that, as a source of warmth, it is much less satisfactory than the English lodging-house fireplace which Howells once described as having "the capacity of a pint-pot and the heating capability of a glow-worm." But modern heat-measuring devices are so sensitive that the imperceptible heat of the Moon's rays may not only be measured with precision, but afford a basis for a reliable determination of the temperature of its surface.

There is no difficulty, in principle, in throwing the image of a planet, or of some portion of the Moon, upon one of the two junctions of a balanced thermocouple circuit, and recording the current set up by the heating of this junction by the incident radiation. In practice, a very high degree of manipulative skill is required, to construct the tiny thermocouples, to keep the galvanometer at the highest sensitivity, and to shield the whole circuit from the many sources of extraneous disturbance. Work of this sort was done years ago at the Lowell Observatory by Coblentz and Lampland, and at Mount Wilson by Pettit and Nicholson—who summarized their observations in an extensive catalogue of "radiometric magnitudes," calibrated so that from the entry for each star it was easy to derive the actual amount of radiant energy which the star sent to a given area of the Earth's surface.

The theoretical interpretation of these data is much complicated by the fact that the energy we can measure at the Earth's surface is much less than we would observe if there was no atmosphere above our heads—and if we could survive to make our measures. The Earth's atmosphere is tolerably (though far from perfectly) transparent to visible light, but highly opaque in many regions in the ultra-violet and infra-red. Hence we lose a great deal of the radiant energy from some bodies (most of all from the hot, white stars) and have to make allowance for this with much labor and pains. The worst of it is that the most powerful absorbing component of the atmosphere is water-vapor, and the amount of this varies from day to day and even from hour to hour. We can get a general idea of the amount of water-vapor above us by measuring the humidity of the air at the ground level—or at that of the observatory floor—by the ordinary methods used by meteorologists. If this air was a fair sample of the great atmospheric ocean which extends a hundred miles and more over our heads, we could proceed comfortably with our calculations; but, obviously when the wind is from the north high up, and from the south low down, the surface air may be a poor sample of the whole.

LUCKILY, there is a "window"—or spectral region in which the air is nearly transparent—for wavelengths about 20 times as long as those of visible light. For longer waves, the atmosphere is entirely opaque, and for shorter ones it is full of regions of heavy obstruction.

This "window" comes just in the right place for the student of planetary temperatures. The heat carried by the sunlight reflected from the planet is, for such observations, only a nuisance. The heat given out from the planet's own surface is what is wanted. This radiation, coming from a surface at a temperature more or less like that of the Earth's surface, is carried mainly by long waves, while sunlight contains a great preponderance of short waves. Of the two clear spectral regions in the transmission of the atmosphere, one lets the sunlight through, little weakened; while the other is open to the planetary heat—though not wide enough to admit it all.

Our thermocouples, of course, measure the sum of both but it is easy to separate them. A microscope cover-glass, 1/150 of an inch thick, blocks out most of the long wavelengths, and a cell containing water between quartz plates obscures it completely—though both are substantially transparent to sunlight. By interposing one or other of these screens in the path of the rays, and repeating the measures, the energy cut out represents approximately that radiated from the warm surface of the planet, and that which still gets through, the reflected sunlight. Exact allowance for the small fractions of either one which are not completely stopped or let through is easy enough. Needless to say, the observations must be made with a reflector, so that the rays are not obliged to pass through any glass.

In this way the reflected sunlight is eliminated, and the corrected reading represents the heat which would be received from the planet itself if the sunlight could be cut off from it for an instant, before it had time to cool.

The amount of this heat evidently depends upon the size of the portion of the planet (in square seconds of arc) whose image falls on the thermocouple. Allowing for this, there remains a quantity which depends on the temperature of the radiating surface. If the surface was a standard radiator — or "black body" — and the atmosphere was not in the way, this quantity would be proportional to the fourth power of the temperature, and the rest would be easy.

Allowance for the loss in passing through the atmosphere demands laborious calculation, but can be reliably made (subject to the uncertainty of the humidity of the upper air). Whether the surface behaves like a standard radiator or emits less is sometimes doubtful; but the Moon is doubtless composed of rocks not much unlike igneous rocks on Earth, and these, for long waves, are not far from standard in their radiating properties.

The amounts of heat which

would be received, by a faultless detecting device, from a body of given size at various temperatures, observed through the Earth's atmosphere under standard conditions, have the following relative values:

Temperature			
			Heat
°K	°C.	°F.	Received
400	127	260.6	1000
350	77	170.6	583
300	27	80.6	285
250	—23	— 9.4	117
200	—73	—99.4	31
150	—123	—189.4	3.2
100	—173	—279.4	0.048

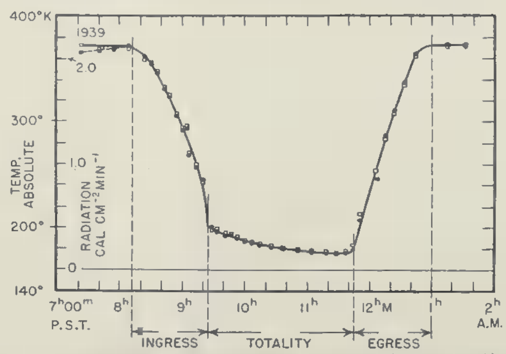
The influence of the transmission "window" is clearly seen in these figures. Were the radiation unobstructed, the heat received would be 16 times as great if the absolute temperature were doubled. Between 200° and 400° the ratio of increase is 32, from 150° to 300°, 88, and between 100° and 200°, it is 650.

Even at the higher planetary temperatures, a great part of the radiation is of such long wavelength that it does not get through the atmosphere. At lower temperatures a larger and larger fraction of the radiation goes over into this inaccessible region until at last only a beggarly remnant remains observable.

This adds to the accuracy of the measurement of planetary temperatures in the middle range, near 200°K., or absolute. At temperatures much below 150°K., there is very little left to measure, and at 100°K. only 1/80 of the already feeble radiation reaches the Earth's surface.

This makes it very difficult to measure the true surface temperatures of the remoter planets of our system, from Uranus outward, for a simple theoretical calculation shows that they are practically certain to be below 100°K.

Taking all these things into account, Pettit and Nicholson derive a formula — which runs twice across the page on which it is printed — in which all the corrections are included. Ten years ago, from a long series of measures on various parts of the Moon's surface, they derived consistent and reliable values for its temperature. The hottest part of the Moon is of course the "sub-solar point" where the Sun's rays fall vertically upon it. As we shall soon see, these rays have had plenty of time to heat it up in the week (measured by our time) since the Sun rose above the lunar horizon, and the surface is practically as hot as it would get if the sunlight kept on playing upon it forever. Under these conditions, the temperature rises to 374°K. (in centigrade degrees above the absolute zero), which is the same as 101° centigrade, or 214° Fahrenheit. At greater distances from this point, where the sunlight falls more



Courtesy *Astrophysical Journal* (May, 1940)

The Moon's radiation and temperature near sub-solar point

obliquely, the temperature gets lower, and the dark side of the Moon is extremely cold.

What would happen if the sunlight should be suddenly cut off? The surface, having no internal supply of heat of any account, would cool by radiation into space how rapidly?

Nature performs this experiment for us every time there is a lunar eclipse. The interposition of the Earth cuts off the sunlight—not instantaneously, but in about an hour. Under favorable circumstances, a given spot on the Moon may remain in darkness for more than two hours and a half, though the time during which the whole disk is obscured is about an hour shorter.

The faint reddish light refracted by the Earth's atmosphere into the shadow, which enables us to see the eclipsed Moon, is so feeble that the heat which it carries can be quite neglected, so that we have practically an ideal experiment.

Lunar eclipses, visible at a given observatory, with the Moon high enough in the sky to be well observable throughout all the phases, are none too common. Pettit and Nicholson observed one at Mount Wilson in 1927 (June 14) and the next one when weather and other conditions were satisfactory happened on October 27, 1939, and was well observed by Pettit. It was not necessary to use one of the great telescopes for the observations — a 20-inch reflector collected ample energy.

The sky was very clear, the weather steady, and the Moon high in the sky. Both a cover-glass and a water-cell were used to separate the reflected sunlight and radiated heat, thus enabling two almost independent sets of temperature determinations. The two are in excellent agreement. In the figure the squares mark the cover-glass observations, the dots those with water-cell. The point observed on the Moon was not quite under the Sun, and the surface temperature there, before the eclipse, was 99°C. As the Sun's rays were cut off, the radiation from the Moon fell rapidly — almost in exact proportion to the loss of incident energy. When totality began (for the observed portion of the surface) its temperature had dropped by 172° centigrade, and was —99°F. An hour later it was lower by 18°C., and, just before the sunlight returned, it was —97°C., or 144 degrees below zero Fahrenheit!

If the Moon's surface were composed of solid rock, it could not cool so rapidly, for heat would be conducted up from the deeper layers, and prevent so precipitate a change. Only a loose agglomerate, like pumice or volcanic ash, could interpose so effective a barrier to the escape of internal heat. Such substances are just what one might expect to find on the surface of our satellite, so that there is no difficulty about believing this. Pettit calculates that the cooling during the recent eclipse, though amounting to a drop of 350°F. at the actual surface, involved mainly only the outermost inch of depth. A few inches deeper, the cooling must have been very small.

During the long lunar night, the surface temperature must fall very low. The slower alternation of these changes would cause their influence to penetrate deeper; but, could we visit the Moon, and find a cavern leading into the surface, we would probably find a nearly uniform temperature, 20 feet underground.

The Earth gets as much heat from the Sun as the Moon does, and has much longer to cool down every night than the eclipsed Moon is permitted. Were there no atmosphere or ocean on our planet, its surface temperature would probably undergo almost as extreme variations. It is in more than one way, therefore, that air and water make our world habitable.

The Temple of the Effigy

Evidences Unearthed in Ohio Afford Clear Proof of a Grisly Mound-Builder Rite

WILLIS H. MAGRATH
Affiliate, The Society for American Archeology

A PREHISTORIC stone eagle effigy, the only one of its type known, according to scientists, was recently unearthed inside an ancient mound, by Roy Saltsman, an amateur archeologist of Alliance, Ohio, assisted by the author.

The stone effigy, unique because of its position inside a mound, is part of the trappings of a prehistoric temple of worship, and has been evaluated by Richard G. Morgan, Curator of Archeology at the Ohio State University, as belonging to the Hopewell Culture of early Mound-Builders.

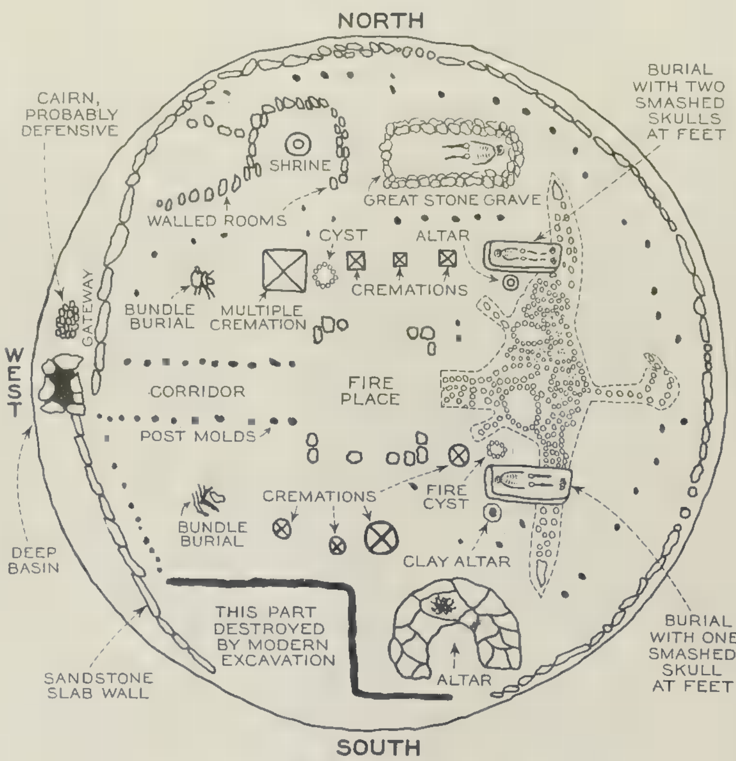
The mound, which occupies a commanding position on the hill overlooking the village of North Benton, in northeastern Ohio, was encircled by large sandstone slabs set end to end. Inside this stone wall, the former existence of a second wall of wood was indicated by the charred stumps of pillars which had supported a nearly circular building 70 feet in diameter. Entrance to the structure was on the west side, through a gateway wide enough to permit the passage of but one person at a time.

Inside the gateway was found a hard-beaten corridor bordered on either side by the black molds of the posts which had helped support the inner parts of the structure.

On either side of the corridor were lines of cremated burials—charred bones on raised, truncated earthen cones—together with crude stone altars bearing the marks of fire. On other squat clay cones, rested offerings of stone implements, mica, cannel coal, galena, and copper, while there were two bundle burials—bones previously buried elsewhere, exhumed and brought here.

The corridor ended in a square fireplace, exactly in the middle of the temple floor, over which there would have had to be a hole in the roof to carry off the smoke of ceremonial fires and the stifling stench of burning sacrificial corpses.

Eastward of the fireplace, where the slanting light of the afternoon sun would strike upon it through the hole in the roof, was the fantastic eagle figure, made of white sandstone slabs resting on an understructure of molded clay. It measured 32 feet across the expanded wings and 16 feet from head to tail, and was headed toward the rising sun.



General plan of the Temple of the Effigy

Overlying the eagle's wings two skeletons were found—the one on the south that of an abnormally large male, that on the north that of a female, the latter showing marks of disease. Both burials were accompanied by rich offerings of flint, bone, and metal.

Among the offerings placed with the male were a pair of spool-shaped copper ear ornaments and a platform pipe, the first such objects to be reported from this region. The inner portions of the earspools were lined with buckskin, secured by a twine wrapping about the mid-section, an apparent indication that these people knew the injurious effect of absorbing copper salts into the skin, and sought to avoid it. A hollow copper globe found with the female is perhaps unique.

These two burials, perhaps those of a king and queen, were distinguished by remarkable deposits of smashed human skull fragments strewn about the feet, apparently an instance of human sacrifice. This conclusion was reached with extreme hesitation, as it is not in accordance with finds made with other branches of the Hopewell Culture. However, a large horseshoe-shaped stone platform found near the eagle's southern wing tip bore evidence that seemed to admit of no other interpretation. This evidence consisted of a litter of smashed human skulls, together with incrustations of ceremonial red paint, upon the slabbed top of the structure. That wanton violence had been visited on these skulls was evident from the smashing of even such solid structures as the mastoid process, while splinters of bone had been driven down into the crevices between the slabs. Gashes in the soft sandstone indicated that the instrument used to effect this demolition probably had been an axe.

THIS barbaric altar was examined in the clean light of open day, under conditions that must have contrasted strongly with its appearance when it was part of a mound-builder temple. Perhaps most of the rituals performed on it must forever remain a mystery, yet enough evidence remains to permit at least a partial reconstruction of what went on here when human heads were smashed and the gruesome fragments strewn at the great chief's feet. For when the great chief was stricken dead, this could indicate only that the gods were angry with the people, and it required atonement which, in the case of someone so exalted, called for human sacrifice.

Illuminated by fitful fires from the sacrificial altars, with such feeble shafts of sunlight as could penetrate the smoke reek, fantastically-garbed priests move about in the space before the curving altar, performing their offices.

The chalk-white slabs of the Eagle effigy catch the light and make a weird background for the figure of the dead chief lying upon a catafalque of sand.

Diagonally above his left shoulder boulders have been placed to form a circle, and now a fire burns brightly in this cyst. As the flames leap higher a priest moves forward, tossing in such personal property as the chief will not want to take with him on his long journey.

Occupying a similar position with respect to the right shoulder is a squat pyramid of molded clay. Upon the pyramidal altar is a greenstone hatchet, a great polished celt of schist shot through with sparkles of white and yellow mica, and several lesser implements. These are the tools the chief loved and the ones he will want to take with him when his soul goes outward bound toward the rising sun upon the strong eagle's wings.

FARTHER back in this macabre chamber of sorrow—back beyond the supporting pillars and the lines of cremated burials—are the living nobles and chiefs, while the gloom-filled area along the temple wall is thronged with still other worshippers, all of them manifesting the most poignant grief.

Behind the ceremonial, horseshoe-shaped altar, facing the worshippers, is the high priest, fantastically arrayed in towering head regalia, earlobes hideously distended with polished copper spools, swart breast hunt with gleaming shells and bear teeth. He has a pouch of ceremonial red paint, and his right hand grasps a massive greenstone hatchet.

The air pulsates with a barbaric rhythm of chants and drumbeats, interspersed at times by the wild shrilling of a Pipe of Pan. Guttural commands ring out and there is a commotion near the temple gate. In a moment stalwart braves enter, dragging a fright-drugged wretch whose mind is too palsied to realize fully what is about to happen to him in this stifling place.

The bedlam grows louder, rising to a supreme pitch as the climax of the rite approaches. The braves have dragged their victim to the curving altar, and are forcing him to bow over the slabbed top in supplication. Menacingly the high priest raises his hatchet, at the same time sprinkling sacred red paint upon the altar. In a moment that altar will be redder than with any ceremonial red paint. A hush falls on the crowd, the hush of emotional mesmerism, and in that moment of hush the blow falls, splitting the skull with a soggy impact, like the bursting of a rotten pumpkin. Again and again the hatchet strikes, till the thing that was a human head is a shapeless crimson pulp, and the body to which it was attached ceases its convulsive twitching and is still.

Pieces of smashed skulls strewn about the feet of the buried Indian queen's skeleton

Part of the eagle effigy, with one of the burials lying across its half concealed wing

Contemptuously the subordinate priests kick it aside, while the high priest sheathes his hatchet. Then the dripping head fragments are gathered up and strewn about the feet of the great chief. Much of the sodden debris is carelessly overlooked, and remains upon the altar, and there the explorers find it, centuries afterward, telling its long-forgotten story.

Even the Pipe of Pan, which must have played so important a part in the ceremonials, was found. It lay upon the breast of an aged man in the great stone grave north of the eagle, a beautifully made instrument, consisting of three

Pipe of Pan. Half natural size

bamboo tubes cased in a copper sheath of surpassing workmanship. Since it lay upon the breast of the skeleton, exactly over where the heart had been in the long past, the finger bones of the right hand still touched it, as though the Player of the Pipes had sought to protect his instrument from desecration even in death.

The Pan Pipe of this ancient musician differs in several ways from the instrument of the classical peoples. Where the ancient Greek Pipe of Pan had seven or more tubes, this one has but three. And, while the classic pipe has tubes of graduated length, to produce different pitches, these people made the tubes all the same length, and controlled the pitch by inserting leather plugs at varying distances from the ends of the tubes. Thanks to the preservative action of the

The "man sign" found in the grave of the piper shown below

poison copper salts of the sheath, the thing has come down to us out of the past intact; we do not have to guess at it construction.

The very old man in the great stone grave was further distinguished by having at his head a large stone tablet engraved with a "man-sign" in relief. The "man-sign" smacks of Mother Asia, and is used in the ideographic symbols of the Chinese even to this day. Now, as for milleniums past, this symbol has meant "God" and "Great". If the "man-sign" meant the same thing with the builders of the Temple of the Effigy that it did with their Asiatic forbears, it would indicate that they followed an anthropomorphic type of worship. In this concept of religion God is pictured as a kind of superior human being, with the form of man—a relatively high culture.

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MOUND BUILDERS

No Longer are They A Complete Mystery

A FULL flowering civilization, not essentially inferior to that of the Aztecs in Mexico or the Maya in Yucatan, vanished without a trace in North America, probably a few generations before the first landing of Columbus.

This is the conclusion of Frank M. Setzler, Head Curator of Anthropology of the Smithsonian Institution, from an effort to reconstruct out of such scattered clues as are available the history of the Hopewellians, the mound builders of the Ohio and Upper Mississippi Valleys [see also details in the preceding article.—ED.]

From the results of more than a century of research, Mr. Setzler explains in a study just published by the Institution, a tentative picture can now be drawn of the ways of life of this mysterious people.

Construction of the large mounds, the surrounding earthworks and the hundreds of smaller mounds, he says, clearly required a dense population and a well coördinated society. This population must have had some stable economic basis. Even though direct evidence of maize is lacking, the practice of extensive agriculture must be admitted, because it alone could have supported the large population aggregates in which the Hopewell people obviously lived.

"There must also have been conscription of labor to construct mounds, which are 30 feet high, 150 feet wide, and more than 200 feet long. To obtain obsidian from the Rocky Mountains, mica from the southern Appalachians, copper from Wisconsin, and amphibians and fishes from the Gulf of Mexico, required time for exploration. Since most of the large mounds were built to cover the bodies of the dead, accompanied by their personal adornments and other objects, one can postulate a well-developed ritual, associated perhaps with a remarkable religious fervor. If a select ruling class existed, they dominated a very large portion of the Mississippi Valley. Copper head ornaments and colored woven garments decorated with fresh-water pearls and mica suggest insignia of aûthority. At least persons with such attire would be set apart from the rest."

This strange civilization, Mr. Setzler believes, resulted from the impact of two peoples, probably without definite conquest by either. A survey of the field shows the same culture, but in a simpler form, in the lower Mississippi Valley and around the Gulf coast.

No clue has yet been uncovered which permits the dating of this development more closely than sometime between the beginning of the Christian era and the coming of Columbus. There certainly were no Hopewellians left when the first white hunters and traders came into the Ohio Valley, for not a single artifact of European origin ever has been found in the mounds. In fact, the country was then inhabited by woodland Indians who had no memory of their predecessors, or even legends concerning them.

No evidence has been found which would indicate that any great catastrophe overtook the people. The whole civilization seems to have faded into extinction for as yet unexplained reasons.

EXAGGERATED

BECAUSE Cro-magnon man had a very large brain, he sometimes is glorified as our mental superior. From a study of his art, W. H. Riddell, in *Antiquity*, deduces that these Old Stone Age people, with 150 centuries less history behind them than we, had minds equal to those of a bright modern boy of 11 or 12 years.

The great stone grave is 11 feet long, six feet wide, and contains approximately 15,000 pounds of dry-wall masonry. Its slab top had caved in

What Makes An Aviator?

Intelligence, Adaptability, Physique, Mental and Physical Health Are Factors

JOSEPH G. LEVINE
Captain, Medical Reserve,
Flight Surgeon, U. S. Army

When the question "What makes an aviator?" was put to a leading pilot, he waved aside the idea that any special genius was his or contributed in any way to the making of any flier. "I think that, in the future," he said, "anyone who can drive an automobile or motorcycle safely and efficiently ought to be able to fly an airplane in safety. Of course, in flying military, transport, and mail planes, perhaps something more is needed, but I do not think the idea that it takes an unusual man to fly is at all sound." Asked to name definite qualities necessary, he stressed particularly mechanical judgment. "It is the meticulous care concerning route and meteorology, and the intelligent handling of mechanical equipment that determines the pilot's length of usefulness in the air."

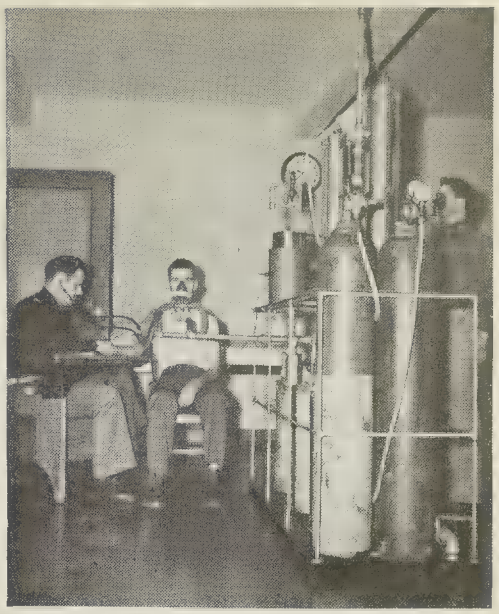
An experienced army flight surgeon often gets a "hunch" from his first glance at a prospective pilot and may predict to himself, as he follows the student through his training, what kind of flier he will become.

Of course the physical constitution of the flier must reveal no defects in all the essentials. The physical examination must be exacting, and is most difficult to pass; for he is subjected to extremes in flying. There can be no history of epilepsy, syphilis, respiratory disease, kidney disease, or any other ailment that may tend to be chronic and recur. The heart, lungs, and nervous system must be sound and free from any defect. Often it is necessary for the military pilot to change direction suddenly at terrific speed. This may cause abdominal pooling of blood and brain anemia in those having a faulty circulatory system, with the possibility that the ship might be out of control long enough for an unexplained crash to follow.

The eyes should be perfect or rendered so by a slight lens correction. There can be no color blindness, for keen vision is essential in determining terrain for landing, night flying, bombing, and in distinguishing military objectives at high altitudes. The glare of the sun from desert, water, and snow; rapid variations in oxygen tension; extremes in temperature and weather; and the roar of the motor all tend to aggravate any weak condition in the near-well individual and may even affect the normal pilot. This stress is tremendously increased during wartime flying.

Flying has a significant effect on the middle and inner ear. The magnitude of the ear problem in aviation may be judged from the fact that pilots suffer more frequently from disturbances of this organ than from all other occupational diseases combined. The conditions of flight which most affect the ear are changes of atmospheric pressure during ascent and descent, noise, and possibly vibration. It has been pointed out that, at the present time, the atmospheric pressure factor is increasing in importance as a result of the increased climbing ability of modern aircraft, while the two latter conditions are decreasing in importance as a result of recent advances in aircraft design.

Pilot operating the device that determines perception of depth



Test of pilot with equipment simulating different altitudes

From experience, it is known that certain types of physique may make for better fliers. Medically speaking, man is divided into three classes: the asthenic, athletic, and pyknic, or obese. Just as an external detail can betray subtle changes hidden deeply in the central nervous system, so may facial patterns and bodily conformations serve to guide the examiner in drawing up his estimate of the applicant's constitutional capacity. Asthenic, in this sense, does not mean frail but rather the lean and wiry type.

Most of the excellent fliers are known to come from the athletic group. This group consistently supplies the first-grade pilots that cannot be surpassed by those of any other nation in the world.

Yet it is observed that some of the superlative fliers are derived from the asthenic group. The more active glands of internal secretion of the man in this group perhaps speed up his metabolism or body processes. His reflexes and power of quick co-ordination are of the hair-trigger variety. He is often proficient in all sports where nicety of judgment, finesse, and polished skill are required. He may turn out to be a crack pilot just because he is a crank for perfection.

Men of the pyknic type are rather unsatisfactory. Their excess poundage is the visible sign of slower reflex activity. Many of them may become good pilots, but, as a general rule—to which there are exceptions—they do not make top-notch fliers. In emergencies they do not tend to do the right thing instinctively. It is not a question

Official photograph, U. S. Army Air Corps
Phorometer examination by Lieut. Col. A. W. Smith, for 20 years flight surgeon and pilot

of intelligence or courage. Flying is usually not the field where they excel, though they do succeed in many professions.

It has been brought out that many American pilots are descended from the Nordic race group. It so happens that pilots from this group are excellent aviators and are second to none of the other race groupings. The Nordic comes from a cold climate. He is blond, blue-eyed, and of athletic build as usually seen in the air service. There is often a piercing quality about his eyes, sometimes referred to indulgently as "eagle eye." That calm, hard, steady gaze is a quality of psychological import. He usually conducts himself modestly but confidently, is emotionally stable, intelligent, self-reliant, and of the "he-man" type.

The remainder, or minority, of the aviators are drawn from the Alpine and Mediterranean racial groups, and an occasional one from other groupings. Their fitness for aviation varies, though not always as we imagine. For example, Courtney states: "A common notion abroad is that Japanese are poor fliers because 'they have no sense of balance; because their nervous reflexes are too slow'." But a Japanese army flight surgeon reminded him that most of the balancing acts we used to see in vaudeville were given by Japanese. "In fact," the surgeon said, "we are endowed with certain racial virtues advantageous to flying. We are small and used to cramped quarters. We are agile, deft, strong. Our greatest difficulty is neither mental nor emotional, but defective vision, which is a national problem."

It would be rather unfair to conclude which racial group makes the better fliers. Indeed, it is not likely that Nature has made any particular geographical belt the breeding ground for birdmen. The flying type is perhaps evenly divided among them all. What is needed is the soil or opportunities of education and proper flying training to develop them.

Military aviation is the field primarily for the young man. The most suitable ages are between 20 and 30, preferably around 24. When one has learned to fly in youth, then, with the constant increase of flying experience, he can safely carry on to middle age. Flying has become a reflex act with him now, and continued experience compensates for the gradual deterioration that comes with age. Of course, when any factor develops that impairs his powers of co-ordination, it is then that he should wisely withdraw. The man in civil life, who learns to fly at the age of 30 or later, learns with the same difficulty as one would who takes up swimming at that period. He is more easily fatigued and must be given his flying instruction in small doses. His knowledge and aptitude in the later years tend toward the synthetic variety.

The pilot-selecting process, from the viewpoint of personality study, is of great importance. The only son, who has been pampered by his fond parents, must always be the center of attraction to be happy. During flying training, he may not do well because of the discipline, and may not get along with his fellow fliers. On the other hand, the young man who has been educated in the school of hard knocks and perhaps has been the leader of his gang as a boy, is to be looked on approvingly. Extraneous worries, which have to be probed for, are responsible for a number of failures. It is by searching into his past life and learning how the student pilot conducts himself in all situations that one can foretell with any degree of certainty how he will act in the future.

In selecting the finished pilot for wartime activity, the temperament of the aviator is taken into consideration. For pursuit or attack aviation, the flier must be aggressive, with calculated, reckless daring and a flair for action with an enemy. In bombardment aviation, the more deliberate and calmly courageous pilot is chosen. He must fly level over his objective for a definite period in order to drop his bombs accurately, despite the anti-aircraft shells that are exploding perilously close and the enemy pursuit planes that are on his tail.

Flying skill is always influenced by the degree of conscious fear that is disturbing one's judgment. The pilot is always pitting his skill against the elements; and, in wartime, against his enemies. It is this constant combat, this game or risk, that is the exhilarating recompense to those who become accomplished aviators. Eternal vigilance is the price necessary for him who invades the realm of the eagle.

A very definite type of young man is cut out for military aviation, just as in any other line of endeavor. The inherited qualities of the mind, tempered by education and experience, with the sum-total of studied foresight and precaution, determine the true flying type.

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50,000 AIRPLANES

How We Can Build Planes at a Rate of 20,000 a Year

It is not yet settled whether the airplane can beat the battleship; but it seems definitely settled that air supremacy means winning a war whether on land or sea. Colonel Lindbergh and Winston Churchill were right when they warned the nations that German aviation was superior to military aviation of all other nations and that this constituted a menace to the world at large. The President is right when he asks for 50,000 airplanes for our national defense, and advises building 20,000 military and naval aircraft in one year.

But can we build 20,000 airplanes a year, even with our vast industrial resources? Yes, provided .... Army and Navy methods of selecting prototypes and placing production orders are greatly simplified and accelerated; Army and Navy methods of inspection and approval are simplified and accelerated; Our trade schools, vocational high schools, and other schools make a great effort to train vast numbers of mechanics; Our trade unions remove their restrictions on the number of apprentices or other means of entry of new men; Our trade unions co-operate in speeding up the national effort of defense; Our universities train

the engineers that will be required in great numbers; The Allied commissions immediately impart all their war-gained information to our Air Services; Our Chief of Air Corps and our Chief of the Bureau of Aeronautics use the dictator's methods in boldly selecting certain types, and in boldly concentrating on those types, and in making up their minds quickly to guide the aviation industry; Our constructors, with permission of military and naval authorities, follow the German plan of building planes and engines which will last 100 hours instead of 5000 hours because the war-time life of a plane is far shorter than the peace-time life of an airplane—we must maintain performance, maneuverability, and gun fire at the sacrifice of durability.

The nation as a whole must willingly shoulder the cost of this program. Congress should appoint a special aviation committee to function energetically and rapidly, and undertake no super-critical investigations. It is better to arm in the air, with mistakes, than not to arm at all.

Our young men must seize the opportunities now being offered for flight training, remembering that the pilots are the decisive factors in modern warfare and that it is somewhat pleasanter to be in the dive bomber than to receive its blasts on the march.

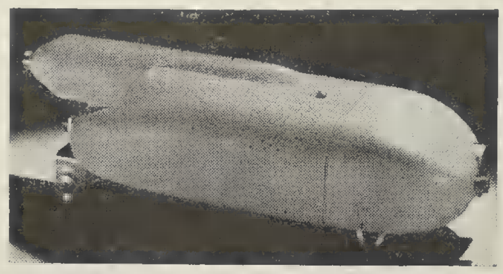
Above all, those concerned must remember that a co-operative, energetic spirit is imperative. Difficulties of production, subcontracting, machine tools, materials, engine bottlenecks, and all other difficulties will vanish provided the people of the United States, Congress, Army and Navy, and manufacturers, all understand that a stupendous effort is necessary.—*A. K.*

CAMERA GUNS

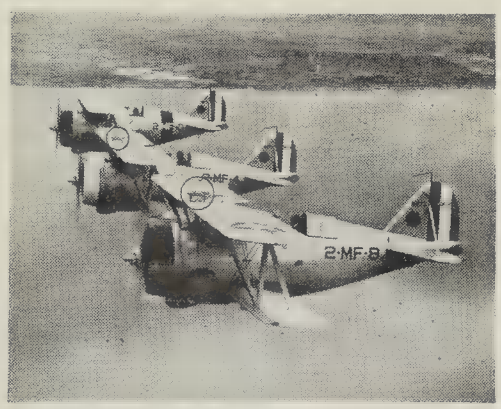
Two Types Permit Economical Aerial Gunnery Practice

With the greatly increased speeds of modern military aircraft, aerial gunnery has become increasingly difficult. The difficulties are apparent when one considers that both target and the firing platform not only move at tremendous speeds but also indulge in violent maneuvers. Accordingly, our own air services and the air services of other countries are more and more resorting to training with the camera machine gun. To H. K. Yulke of *Fairchild Aviation News* we are indebted for an account of this interesting equipment.

Two types of camera machine guns are now in use, one for fixed installations and the other for movable installation. The movable camera gun simulates as closely as possible the weight, size, appearance, and method of manipulation of the regulation Browning or Colt aircraft machine guns. The fixed camera gun is operated like the ordinary fixed machine gun, but bears no similarity to a real machine gun; it is mounted above the wing, near the leading edge.

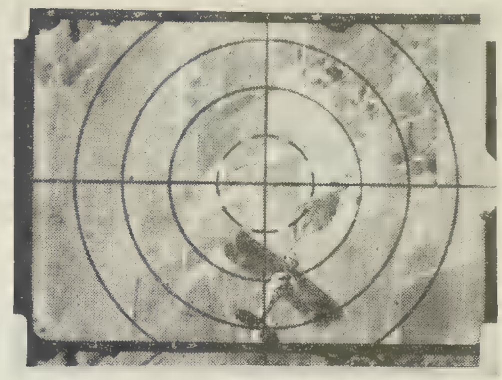


Above: Fixed type camera gun, and, below, cameras (in circles) mounted on upper plane wings



Some 4000 Fairchild camera guns are used throughout the world, and their development over a long number of years has been a matter of very skilled technique. Loading the film takes but an instant and is extremely easy; it is impossible to load incorrectly. In actual operation there is a maximum of simplicity. The camera starts to operate as soon as the trigger is held down. The methods of trigger control are exactly the same as in real machine guns — by pressure of the thumb in the case of the flexible gun and by handgrip pressure on the trigger switch attached to the airplane control stick in the case of the fixed gun.

A rotary disk shutter is employed and a small glass plate, on which are engraved the concentric circles of the reticle system, is located between the shutter and the focal plane. Each film magazine has a capacity of 25 feet of 16-millimeter film, sufficient for 700 shots or exposures. The recording mechanism consists of a split-second watch and celluloid data card mounted on a removable panel, and four small incandescent lamps for illuminating the watch and data card at the instant of exposure. Motive power for operation of the shutter tripping mechanism is provided by means of a strong spring.



Film frame from camera gun

In the reproduced enlargement of a single film frame, taken during a violent mock combat, it is quite clear that the attacking plane from which this picture was taken was in a steep dive upon the target plane.—*A. K.*

CRASH TRUCKS

Pick Up Aircraft After Crashes or Forced Landings

A new and unusual type of crash truck is being built for the Air Corps by The Corbitt Company. These units are to be used in salvaging aircraft that have made forced landings on ground from which they are unable to take off, or aircraft that have crashed. They are believed to be the largest of the type in the world, consisting of a 198-horsepower tractor unit equipped with crane and hydraulic jack, and a trailer 55 feet in length. The capacity is 15 tons.

At the scene of operations, the tractor is unhitched from the trailer and then moves around to the side to lift the plane aboard the trailer by means of its crane and hydraulic jack. If the plane is in soft ground, the tractor may stand on hard ground some distance away and pull the trailer in toward it by means of winches.

The transmission has five speeds forward and one in reverse in two ranges, thus giving a total of ten speeds forward and two in reverse. Furthermore, the tractors are six-wheel drive.

Is Your Pet Dentifrice Safe?

Most Dentifrices Are Good but Many of the Claims Made Are Not Justified

ALBERT G. INGALLS

Few of us accept the daily war communiques literally. Most of us discount their obvious untruths and exaggerations, if any, and mentally fill in omissions where we think they are not altogether frank. Even though their writers should wish to do so, they find they cannot stick to prosaic fact, because the competition is so intense. They discover also that the calculated inaccuracies are accepted by at least some of the people.

In the long-standing "war" of trade between makers of dentifrices the competition also is intense. Some of these makers similarly have discovered that not all of the public appreciates frankness. Even the intelligentsia aren't always too intelligent when it comes to evaluating claims for merchandise. Therefore, not all the claims for dentifrices have been altogether frank, either.

This is not, however, one more "awful grievance" article, since most of the nationally known dentifrices are safe. Sometimes—generally, in fact—the grievance lies only in the extravagant claims made for the dentifrice.

Just what can a safe dentifrice reasonably be expected to do? First, what are some of the things it cannot do?

No dentifrice, safely or otherwise, can keep the mouth germ-free. If it could kill the germs it would damage the mucous membranes of the mouth, and even if it could kill the germs without this damage, its effect would be transitory because the saliva would soon wash it away and more germs would come in. Besides, we are not as frightened about germs as we used to be.

Similarly, dentifrices cannot prevent acid mouth, because their effect is so transitory. Moreover, it is entirely normal for the human mouth to be acid. Just a matter of physiology.

No dentifrice can prevent tooth decay. Even after an immense amount of research, science has not fully reached the answer to the question of the cause of decay in teeth, but present indications point strongly toward something related to the diet. The immediate cause, however, is the chemical action of acids on the teeth. These acids form at inaccessible places in the teeth—most often between the very close, tight folds in the chewing faces—through the work of microörganisms on foods. Brushing the teeth may help, but even brushing them with the best dentifrices cannot stop decay, since it does not remove the cause.

Nor can any dentifrice prevent, competently treat, or cure pyorrhea. This is a job for a dental surgeon—often a difficult job at that.

Halitosis! Bad breath. How can a dentifrice competently treat this? It is caused sometimes by stomach disorders, sometimes by nasal or sinus disorders, infected tonsils, decayed teeth or other diseases, and is therefore only a symptom, not a disease. Treating halitosis with a dentifrice is therefore merely "treating the symptom," something the old doctor tells the young doctor never to do. Of course, a dentifrice that would really cover up halitosis even if it did nothing else, would be a real boon to the world—almost as great as would have been Vice-President Marshall's famous good five-cent-cigar—if only it would last more than a brief time after its use.

Really insidious are claims for tooth whiteners, since these preparations contain acids — hydrochloric acid, for example. Nor will they always whiten teeth, since some teeth never were white to begin with. Teeth vary in hue just as complexions do, and just as naturally.

Massaging the gums with dentifrices may do a limited amount of good, since it stimulates the circulation, but it is the massaging that does the good. This is not, however, a fully competent treatment for hardening the gums.

Use powders because your dentist does! This sounds logical but dentists do not use powders because of any inherent superiority due to their dry form. In fact, the dentist makes a paste of the powder he uses, by first wetting it. Toothpastes also contain powder. Dentifrices are put up in paste form, generally with glycerine as the carrying liquid, because this is the form in which the public can most conveniently use them. This is not to argue against tooth powders but only against some of the claims made for them.

Dentists deny that the glycerine in toothpastes softens the gums, as some makers of powdered dentifrices have said. Concentrated glycerine is, of course, always thirsty: it seeks water (is "hygroscopic") and will take it wherever it can get it, but the small amounts used in brushing the teeth are not considered by dental authorities to be a menace or a danger. The argument, therefore, that glycerine softens the gums is empty.

Having subtracted these main items from the total that have been claimed for dentifrices, what real values are left?

To begin with, the toothbrush itself is the most valuable factor in mouth hygiene. The dentifrice is its junior assistant. Most dentifrices contain two principal ingredients designed thus to assist: one is soap, or a soap substitute. The other is an abrasive. Abrasives must be mild, and not as hard as the teeth. A third and liquid ingredient, often glycerine, acts as a vehicle, as previously described, and a flavoring agent, the fourth, helps make us want to brush our teeth when we feel lazy, as most of us often do.

Soap and abrasive — together these do a lot, but a dentifrice won't cure spavins. Makers who claim little more than that dentifrices help cleanse the teeth—and there are some who do—hit closest to the simple truth, and for this alone a good dentifrice is more than worth to us what we pay for it.

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BLEEDERS

New Substance Clots Blood Instantly

Bleeders, from new-born babies to patients on the operating table and even, in many cases, hemo-

philiacs suffering from the hereditary bleeding disease, can now be saved by two death-defeating substances presented by Dr. H. P. Smith, State University of Iowa.

One of the anti-bleeding substances is a new preparation so powerful that, when sprinkled on a wound, it stops bleeding by clotting the blood "in the twinkling of an eye." It is obtained from beef blood. This material is so fast in action that it will clot blood in one second. It is not yet on the market and the supply is still limited but surgeons at the University of Iowa have already used it, with "quite encouraging" results, to stop dangerous oozing of blood during major operations. This oozing, which is difficult if not impossible to stop by other methods, is especially troublesome in operations on the brain, liver, and bone. When the material is available generally, dentists will also be able to use it to stop bleeding after teeth are drawn. For hemophiliacs, such as the Spanish Count of Covadonga, who recently bled to death from injuries following an automobile accident, the new thrombin may prove life-saving.

Thousands of new-born babies and older patients suffering from obstructive jaundice can be saved from bleeding to death by the other substance which Dr. Smith discussed—vitamin K. This vitamin not only stops bleeding but, if used properly, will prevent the bleeding, Dr. Smith emphasized. The vitamin was discovered by Prof. H. Dam of Copenhagen. Its chemical identity was determined and it was prepared synthetically by scientists at the St. Louis University and the University of California. It was first used to treat patients by Dr. Smith and by doctors at the Mayo Clinic. —*Science Service.*

THEELIN

To Speed Knitting of Broken Bones

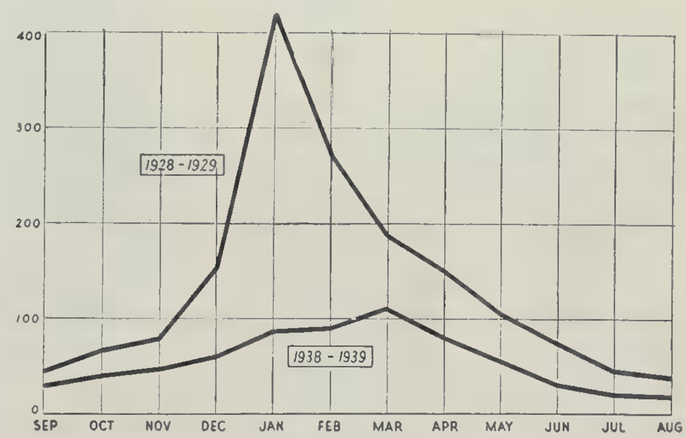
KNITTING of broken bones, especially in elderly women, may be speeded by treatment with the female sex hormone, theelin, Dr. G. A. Pollock, of the Mayo Foundation, declares as a result of studies of the effects of theelin on broken bones in laboratory animals.

Women over 60 years of age get so-called "broken hips" with "striking" frequency, Dr. Pollock points out. The condition, although popularly known as a "broken hip," is actually not a break of the hip but of the neck of the thigh bone near where it is joined to the hip. A change in the bones of older women suggested a relation to the cessation of ovarian function in women past 50 years. Several other scientists, Dr. Pollock found, had also noted a relation between female sex hormones and bone formation.—*Science Service.*

LICKED?

New Drugs and Methods "Encircle" Pneumonia Germ

IF 1938 and 1939 can be taken as representative of an established situation, the pneumonia season—winter—has suddenly lost much of its dread, according to data assembled by the Metropolitan Life Insurance Company. New serums, sulfapyridine and allied drugs, have abruptly cut the winter peak mortality from pneumonia to about a quarter of what it was —as the accompanying graph shows.



Comparison of pneumonia mortality cycles

"Certainly," says the company named, "the experience of these last two years augurs well for the future. We have good reason to be optimistic, in the light of the new methods for pneumonia treatment now being rapidly extended to all parts of the country. Just a short time ago serum therapy was used in only a few cities and states. But now the advantages of serum are generally known and applied. Perhaps even greater successes may be expected from the recent advances in chemotherapy. The full possibilities and limitations of the new drugs have not yet been defined, but the use of sulfapyridine and allied drugs has already yielded most gratifying results. It may be that the most efficient form of treatment will be found to combine sulfapyridine and serum."

BRAIN WAVES

Practical Uses for Laboratory Discovery Steadily Increase

BROADENED use of brain-wave detection already has aided surgery, anatomy, and physiology, according to Dr. Ralph W. Gerard, associate professor of physiology of the University of Chicago.

The noted neurophysiologist and pioneer in the study of brain waves —tiny electrical currents continuously emitted by the brain—enumerated recent advances through brain-wave study. Detection of brain-wave irregularities aids diagnosing and locating brain tumors. It makes possible, too, the detection of epilepsy in its first stages. The anatomist can detect the nerve tracts which carry stimuli from various parts of the body to the brain, while the physiologist attempts to find out the why and how of brain waves, and has at least partly succeeded.

Recent research on brain waves has revealed that the temperature of the brain cells increases the rate of their electrical rhythm, possibly with some bearing on the use of artificial fever in treating insanity; that sedative and anesthetic drugs producing sleep slow the rhythm, while caffeine steps up the waves to more than ten times their normal size.

BLOOD RAYING

Infected Blood Now Taken Out, "Sun"-rayed, Put Back

BLOOD poisoning and some other infections are being treated by removing some of the patient's blood, giving it a quick treatment with ultra-violet rays, and returning it to the body at once. Dr. George Miley, Philadelphia physician, recently announced the method's success.

This is not in itself a new treatment but one that previously failed: the rays did not reach clear through the blood treated. Success resulted when a system of baffles kept the blood turbulently turning over.

Why Universal Fingerprinting?

Desirable Features of System Far Outweigh Erroneously Imagined Criminal Aspects

FREDERICK KUHNE

Former Sergeant, Bureau of Identification, Police Department, City of New York. Author of "The Finger Print Instructor."

THERE are only two reasons why anyone should object to the enforcement of a universal fingerprint law: Either he wishes to cover up some past wrong-doing, or he is afraid that sometime in the future he may be guilty of a violation of law. In either case he knows that registered fingerprints could well be the means of bringing him to justice.

On the other hand, every honest and upright person, citizen and alien alike, should welcome a universal fingerprint law. Through its enforcement would come many personal as well as national advantages, the most important of which are outlined in the following paragraphs. When these advantages are fully appreciated, there should be little opposition to universal fingerprinting; indeed, there should be increased demand that such a system be inaugurated with a minimum time loss.

It is undeniable that much of the popular opinion against universal fingerprinting arises from the erroneous impression that fingerprinting is indelibly linked with crime. That it has been of tremendous value to law enforcement officers in connection with criminal cases is, of course, true. But it must not be overlooked that the lessons learned in this work can be and have been applied in non-criminal work to the great benefit of the honest private person. Fingerprinting, proved an infallible system for establishing identity, has made possible positive identification of amnesia victims, unknown dead, missing persons, and so on. And who can forsee when some accident, some unpredictable event, will make such identification desirable in his own case?

Fingerprinting of all military forces during World War I, plus the voluntary filing of several thousands of prints in the Civil Division of the F.B.I., has done much to lessen public objection to the system. There is still a large majority of residents of the United States, however, who feel that compulsory registration of fingerprints would violate their constitutional rights. Hence the following summary of some of the favorable aspects of universal fingerprinting and recording under government control.

Such a system would do away with the present expensive method

Persistency of fingerprint ridges is demonstrated by these two prints: one at left was taken in 1892; one at the right in 1922

of taking the census every ten years. The records would give a continuously corrected census of the nation, divided by states, counties, cities, towns, and villages.

It would also give a complete record and control of the movements of all persons in the United States, whether resident or entering or leaving. It would prevent the deported from re-entering and the fugitive from leaving the country. It would prevent the falsification or forging of passports and would serve as a deterrent to other infractions of the law.

With universal fingerprinting in force, any national emergency could be met with little loss of time. The records would make possible a speedy call to arms and would prevent draft dodging. Furthermore, those in authority would be able to compile records showing the exact numerical strength of every classification of persons, together with ages, occupations, and other important information.

Record files of a universal fingerprinting system would be of great value to the post office. From them could be obtained correct addresses for improperly addressed mail, thus materially reducing the amount of mail sent to the dead letter office and hence reducing the cost of maintaining this office.

Civil service applications could be acted upon with speed and accuracy from the data supplied by fingerprint files. With this information available, it could be definitely known at all times that only honest persons would secure appointments to this important service.

Couple the foregoing with the more obvious applications of universal fingerprinting to the curtailment of criminal operations and we find a multitude of favorable reasons as against the few and erroneously conceived unfavorable reasons.

Establishment of a universal fingerprinting bureau might appear to be a gigantic proposition. It would be, however, an undertaking no greater than our present system of handling the mails, and the cost would be negligible. Post offices, which are equipped to serve every resident of the United States, could be used as headquarters for fingerprinting those who reside within each postal district. Thus there would be no additional expense incurred so far as office space is concerned and the money saved, by abolishing some of the present activities which would no longer be necessary under universal fingerprinting, would more than pay for the additional help required to handle the routine of fingerprinting.

THE system of enforcing universal fingerprinting could be worked out through the post offices in somewhat the following manner: All present residents would be required to report within a specified time to their local post offices. Here two sets of fingerprints would be taken, one to be forwarded to a central bureau at Washington, D. C. and the other to remain on file in the district post office. When a resident moves out of a postal district, it would be compulsory for him to notify the postmaster to this effect, giving the date of his removal and the address to which he is moving. Upon receipt of such notification the postmaster would then enter such changes on the fingerprint record and would also notify the central office. If a resident is to move to some other point within the same postal district, the duplicate print would remain in

the local office. If, however, the new address is within another postal district, the print would be forwarded to the postmaster of the new district so that the record would be complete at all times.

Of course, it would be a necessary part of a universal fingerprint law that each resident of the nation should be required to carry an identification card containing appropriate data. This card should also bear a simultaneous plain impression of the right index, middle, and ring fingers, similar to those now used by banks and the postal savings department.

Thus it will be seen that a universal fingerprinting system could well be established in the United States with a minimum of expense and a maximum of desirable results. The advantages that would accrue to the average resident would, indeed, far outweigh any residual feeling that he might have regarding the criminal taint of fingerprinting, particularly so when he realizes that this taint is one that should long since have been discarded as having no foundation in fact.

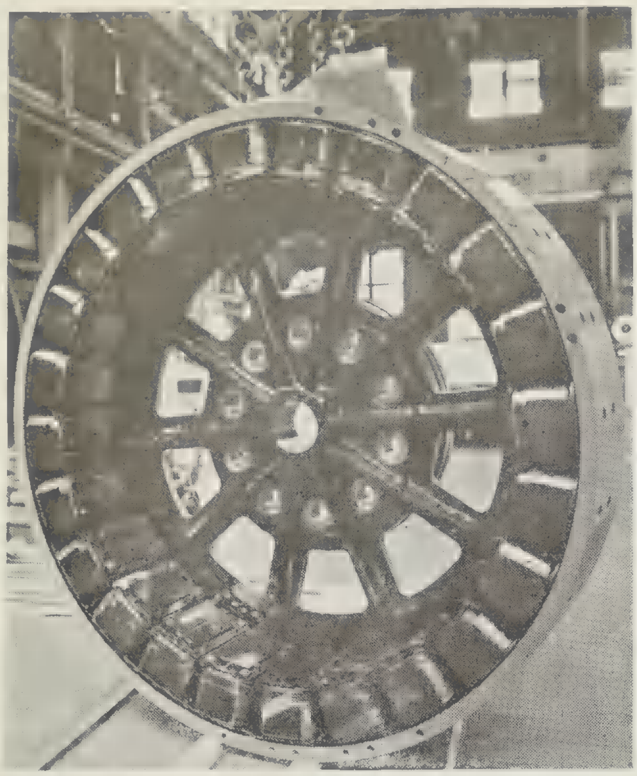
• • •

HEALTHIER PLANTS

Vitamin-Hormone Stimulant in Powder Form

FROM the Horticultural Department of the American Chemical Paint Company comes news of the commercial production of a vitamin-hormone stimulant, Transplantone, for plants, that not only invigorates old roots but also multiplies the production of new ones, reduces the loss which frequently occurs with transplanting operations, and reduces wilting. It is applied to rooted plants to add to existing root growth and to force their general growth.

Transplantone is a water-soluble powder impregnated with Vitamin B-1 and other parts of the Vitamin B fraction, plus root-promoting hormones. The hormone initiates root growth and plant physiologists assert that the Vitamin B chemicals are necessary for the maintenance of their growth. That it is quite concentrated is obvious for it requires only one level teaspoonful to a gallon of water to make a stock solution which is then further diluted. Seedlings may be lightly sprinkled weekly, or it may be applied to plants set out in the soil, whether they be trees, shrubs,



Engine vibration in marine installations is not transmitted to the ship's propeller when this new type of electric coupling is used. Built by Westinghouse, the coupling consists of an armature connected solidly to the engine shaft and a field connected to the gears that turn the propeller. These two rotating parts are separated by a small air gap; when the armature is rotated by the engine, magnetic forces are set up which turn the field (shown at left) and hence turn the propeller shaft of the ship

vines, annuals, or perennials. In the case of plants which are set out without a ball of earth, the manufacturer recommends that the roots be soaked in the stock solution for an hour. Treatment usually results in vigorous and extensive root growth and this, in turn, requires more frequent watering than is ordinarily necessary.

The manufacturer further claims that, owing to frequent clipping, grass is unable to produce enough vitamin and hormone naturally for the roots and that watering with an ounce of stock solution to three quarts of water will improve turf quality. Sods similarly treated before being set in place will also readily form new roots.—*C. F. Greeves-Carpenter.*

HEROIC CASTING

Largest Ever Cast in Stainless Steel

A BRIGHT new symbol of America's free press, the first heroic sculpture cast in stainless steel, was unveiled recently on the facade of the Associated Press Building by Nelson Rockefeller, before a distinguished assemblage. Kent Cooper received it for the Associated Press.

This 10-ton plaque of bright metal was made from the winning design in the Rockefeller Center-Associated Press open competition for a sculpture symbolizing news and the press. Its designer was sculptor Isamu Noguchi.

The 23-foot by 18-foot model, sculptured by Noguchi in plaster, was but a beginning for eight months of labor by engineers, metallurgists, molders, machinists, and polishers who blazed new trails in perfecting the technique that made possible the jump from a few hundred pounds, the largest preceding art work cast in stainless steel, to this titanic 10-ton bas-relief.

Completion of this panel marks several "firsts" in the artistic, architectural, and metallurgical fields. Noguchi is the first American artist to use cast stainless steel as a sculptural medium, and the Rockefeller Center architects are the first to demonstrate the use of a light-reflecting metal to replace the traditional light-absorbing stone and metal decorations of buildings. The General Alloys Company, pioneers in stainless steel, solved many technical problems involved in casting this panel which is twenty times larger than any previously cast. The work involved the engineering of special equipment, the development of synthetic sands to withstand the terrific heat of the molten metal, and powerful precision grinding machines to achieve "invisible" joints in the finished plaque.

FLOOR SEALER

Finish Penetrates Wood Grain, Gives Protection

AN attractive and durable finish for unfinished floors has been put on the market by American Asphalt Paint Company. The manufacturer claims that it furnishes absolute protection against dirt, water, grease, and constant wear.

Through its active penetration into the wood, this new finish, which is called Valdura Floor Sealer, seals the grain and gives a waxed and polished appearance, with no surface coating to wear off. Therefore, floors finished with it are said to retain their original color, or natural wood finish.

Valdura Floor Sealer can be applied with a mop or a brush. One coat only is needed, and one gallon covers about 800 square feet of floor surface. Three or four hours drying time is all that is necessary before the floors are subjected to foot traffic. The sealer may also be used to advantage on logs, knotty pine, creamery churns, and other unfinished wood.

BATTERY CONDITION

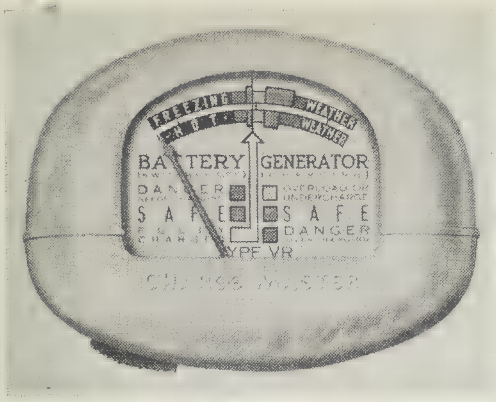
Indicator Shows When Battery May Fail

TO protect car owners against the yearly toll of battery failures due to overcharge or undercharge, an accurate, dependable "battery condition indicator" has now been refined and made available for use on the dash of any automobile as an accessory.

This new instrument — called Charge-Master — indicates to the car driver the state of charge of his battery when at rest. When the generator is charging, the instrument shows promptly any variation in battery charge, in generator performance, and in load (such as radio, heater, and so on) on the electrical line. It shows overcharge and undercharge — each of which may shorten the life of the battery and, if pronounced or continued over a long period of time, may disable it beyond repair.

Charge-Master installs on any car, bus, or truck in about 10 min-

Arrow points to battery condition indicator on motor-car dash



For storage battery protection

utes. The wiring is simple. The instrument is self-illuminating whenever the dash lights are turned on.

Car owners too often have unfairly blamed good batteries and good service men for sudden battery failures and repair costs due to heretofore unindicated overcharge or undercharge. This new device lays the blame where it should be, tells when to turn on or turn off the electrical load from radio, heater, lights, and other equipment in order to hold line potential and battery charge within safe limits until a preferred service man can be reached for timely preventive service.

DUST MASK

In an attempt to provide adequate protection against air-borne dusts, pollen, or certain bacteria which annually cause untold suffering and the loss of millions of dollars, an American Optical Company research scientist — W. H. Lehmberg — has designed an exceptionally light and efficient filtering device for wearing over the nose and mouth to protect the respiratory system.

Weighing only an ounce and a half, and excluding particles of dust as small as a micron — 1/25,000 of an inch — the device was developed to give comfortable protection to those working in dusts; persons allergic to pollens causing hay fever or asthma; and doctors, nurses, and patients exposed to certain air-borne bacteria.

The high filtering efficiency of the new respirator is actually needed, because silica dust now generally considered harmful to the lungs is approximately five microns or less in size; common pollen grains which cause hay fever and asthma range in size from 10 to 100 microns; and bacteria are approximately one micron.

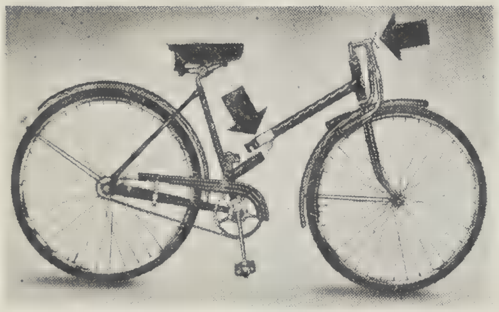
The effectiveness of the new mask, which is lighter than any

other of equal efficiency, is due to four factors: A new method of making the filter unit, resulting in an extremely large, efficient filter area for the size of the mask; a new and efficient exhalation value; a new self-equalizing double head-band which holds the mask securely but comfortably against the face regardless of the position of the head; and a facial design that enables one to wear the device with perfect comfort.

FOLDING BICYCLE

For Ease in Carrying

THOSE of us who were growing up in the days before the automobile era may wish that when we were young there had been available a folding bicycle such as the Compax Sports Traveler recently announced by the Westfield Manufacturing Company. Not only may this bicycle be taken apart in 15 seconds without the use of tools, but, because it has no top-cross bar, the one model fits adults and juveniles of both sexes. Because of its compactness when folded up, it can be carried conveniently in automobiles, busses, trains, and other conveyances. That is an important advantage in these days when many people must travel to the country for their cycling.



Simple joints for folding

The single cross bar of this bicycle, running from just beneath the handle bars to a point on the rear half just above the sprocket, has a slip joint with a single nut for tightening. The machine breaks apart at this point so that the two wheels may be folded together while the handle bars will swing downward for greater compactness.

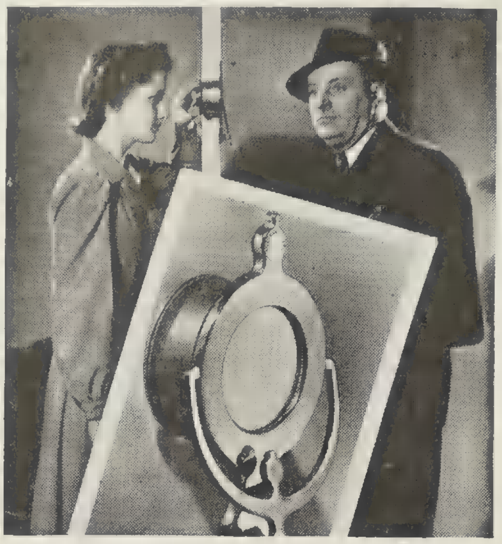
PEEP-SIGHT

Gives One-Way View

Through Front Door

ALARMED by the appalling growth of attacks on housewives by criminals who ring doorbells and force their way inside when the door is opened, police throughout the country are warning women and all householders in urban areas to be on constant guard against this menace.

Various protective methods, such as doorchains and special latches have been suggested, but a very effective new device is an ingenious affair called the "Protective Eye."



Protection for the housewife

This safety device takes the form of a handsome and entirely innocent appearing door-knocker. In its center is hidden a bulls-eye of "one-way glass," making a tiny window which enables the housewife to look out and see any caller without that person being aware of the inspection. Having surveyed the caller, she can refuse to answer the summons or open the door as her judgment dictates.

The secret of the "Protective Eye" lies not only in the inconspicuousness of the glass but in the fact that it has one-way vision. That is, you can see outside from the inside, but not inside from the outside.

TREE PROTECTION

Spray Coat Reduces

Dehydration

A NEW tree spray called Protex is being offered by Protex Industries, Inc. It was first successfully used at the New York World's Fair, and officials praise it highly as a spray to reduce dehydration and obviate excessive pruning. It does not wash off the tree and prevents excessive transpiration without restricting respiration. The makers recommend Protex as being superior to burlap, straw, or other wrappings in extreme temperatures. In addition to a winter Protex, a summer consistency is also available and is designed to prevent sun scald or scorch. The product is a rubber compound and forms an elastic coating that reflects the rays of the sun, thereby preventing wide extremes of temperature.—*American Forests.*

WOOD STOVE

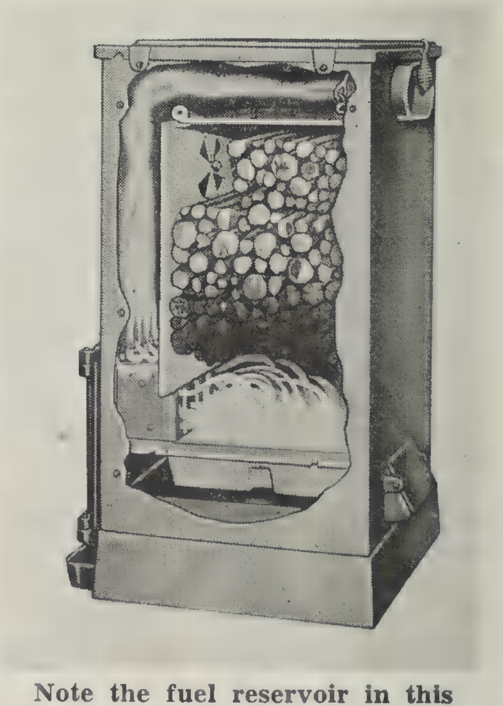
New Principle Achieves

90 Percent Efficiency

DEVELOPMENT of a new type wood burning stove, capable of heating two or three rooms and requiring filling only once or twice a day, is regarded by New England foresters as bringing new hope to farm woodlots which have long suffered for lack of a suitable market for cordwood.

The new stove, developed by the Connecticut Forest and Park Association in co-operation with Prof. Lauren E. Seeley, Yale heating expert, burns wood at an estimated 90 percent efficiency. Because of a radically new design, the heater operates on the principle of "destructive distillation," burning both gas and charcoal formed in its operation.

A cord of hardwood has fuel value approximately equal to that of a ton of hard coal. The heater, shown in our illustration, will hold about two and one-quarter cubic feet of wood, or more than 50 pounds. Small-diameter trimmings from sawmill operations or from "weeding" the family woodlot are recommended in preference to the larger chunks commonly used in wood stoves. As wood is burned in the combustion chamber at the bottom of the stove a fresh supply is dropped automatically from the reservoir above, producing steady



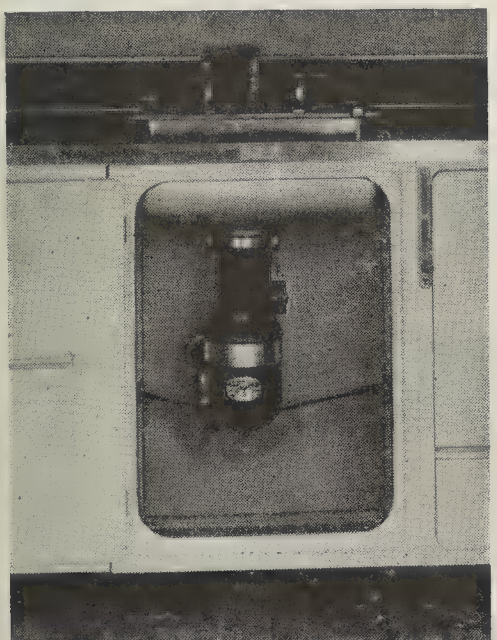
Note the fuel reservoir in this efficient wood burning stove, for homes, garages, and camps

heat for long periods without reloading.

Prof. Seeley estimates that the heater will generate heat sufficient for two or three rooms in cold weather—for an eight-hour period without attention. In mild weather the heater will easily run more than 24 hours without attention.—*Science Service.*

GARBAGE GRINDER

A NEW under-the-sink garbage shredder has been developed by the In-Sink-Erator Company. It is designed to eliminate the unsightly and smelly garbage pail, for all garbage is simply dumped into this device and when the motor is



switched on the garbage is so ground that it may be washed down the drain. This includes such things as bones and fruit pits.

The shredder head on this device, which is powered by a 1/4 horsepower motor, operates alternately in one direction and then in the opposite, so that garbage is cut either into very tiny pieces or pulverized. It is connected with the house wiring system and requires during the very short time it operates only about as much power as the average electric iron.

ELECTRICAL HAIR BRUSH

WHILE it is not possible to say definitely whether vigorous brushing of the hair has any great retarding effect on the advancement of baldness, such brushing is often recommended to stimulate the scalp and give tone to the hair. For those who believe that stimulation of the scalp does assist natural growth of the hair, the Hershey Manufacturing Company has just developed a power-driven

scalp brush. The several rows of bristles are so driven, at 5000 strokes per minute, that a definite cyclic sequence is maintained.

There is at present a professional model of the Vitabrush; a portable model for home use will soon be available.

COTTON WRITING PAPER

DETAILS are as yet unavailable as to the new process for making a high quality writing paper directly from cotton — low-grade cotton, at that — but the development work was done by the U. S. Department of Agriculture in co-operation with the Writing Paper Manufacturer's Association. Provided that the process is a commercial success and paper can be made cheaply enough to create a big demand for it, then this should solve a sizeable part of the problem of what to do with America's surplus cotton.

Count Morner and life-saving suit with kapok-wadded vest

LIFE-SAVING SUIT

Seals Up Water-tight and Warm

A LIFE-SAVING suit of a new design has been invented by a Swedish engineer, Count H. G. Mörner. The Mörner life-saving suit is made of water-proofed fabric, closed in front by a special rubber "zip"-fastener. The suit — boots and mittens being all in one — is put on as an overall in less than one minute, the inventor claims, but it is intended to be worn by seamen all the time, although open, while the ship is in a danger zone. Its buoyancy is due to a special kapok-wadded waistcoat, sewn into the suit, which keeps the shipwrecked floating, even if there should be a leak in the suit. Besides keeping the person afloat, the suit warms him while he is in the water, and it also prevents him from freezing to death if and when he is rescued in lifeboat or raft.

Designed for seamen, this life-saving suit is quickly closed by means of a "zip" fastener

ROCK-PILE RESERVOIRS

Ancient People Collected Drinking Water on Rocks

THE British dew ponds described in the *Industrial Bulletin* of June, 1938, were not the only means of extracting water from a moisture-laden, but stingy, atmosphere. According to a recent issue of *Discovery*, medieval townsmen of Theodosia, a Black Sea port on the southeast of the Crimea, obtained sufficient water for a flourishing city by erecting, on the near-by heights, great piles of broken stones upon which the moist breezes from the sea would condense some of their water. Thirteen of these piles, connected with the city by a system of sandstone pipes, supplied 16,000,000 gallons of fresh water daily and permitted Theodosia to become the most important port on the north coast of the Black Sea.

Barbaric conquerors permitted the stone piles to become overgrown with vegetation, which destroyed their effectiveness. It was

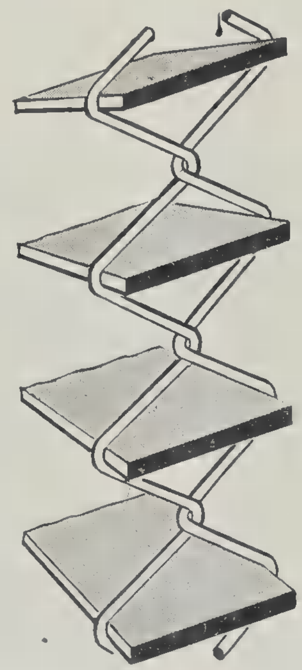
not until the later nineteenth century that the purpose of the piles was again learned and efforts made to restore them to usefulness. Modern engineering methods were not, however, immediately successful in duplicating the empirical work of the original builders; one attempt to do so failed and thereafter political conditions prevented further efforts.

Successful construction of both dew ponds and stone condensers depends upon secrets which are not yet common knowledge. Yet the theory of their operation is simple and a determined effort might cut through the time-fostered traditions of failure. Successful operation would bring life to many an arid seacoast locality and to coral islands whose porous substructure will not permit retention of water, even though rainfall is ample.—The *Industrial Bulletin* of Arthur D. Little, Inc.

SCREEN

Dazzle-Damping and Insect-Proof

THE newest thing in window screen materials is something like a miniature Venetian blind. Called Koolshade, it is made of horizontal flat strips of bronze, woven together every half inch with vertical



Section of bronze wire-and-strip window screen, enlarged 20x

bronze wires. The spacing is the same as in the standard 18-mesh screen and is, therefore, equally insect proof.

The horizontal flat strips serve to kill some of the glare of brilliant summer skies, but let in plenty of light horizontally.

CAMERA ANGLES

Conducted by JACOB DESCHIN, A.R.P.S.

Light Control With an Electric Meter

THE mere purchase of an exposure meter of the photo-electric type, today generally regarded as the most efficient method of light measurement available to the practical photographer, is by no means a guarantee against incorrect exposure—unless the meter is properly used. It is not enough merely to point the meter; it must be pointed toward the subject with due regard to the angle at which the meter is held and its distance from the subject. Furthermore, many workers fail to take advantage of the various methods by which the photographer may truly obtain the full control of exposure that his meter can provide for him.

Beginners usually start off by deciding on the particular subject matter they wish to photograph, pointing the meter in that direction and adjusting the camera settings in accordance with the reading thus obtained. What happens? If it is a landscape with beautiful clouds in the background, the foreground is frequently under-exposed. If it is a portrait, outdoors or indoors, the face is either over-exposed or under-exposed, depending on the brightness or darkness of the background.

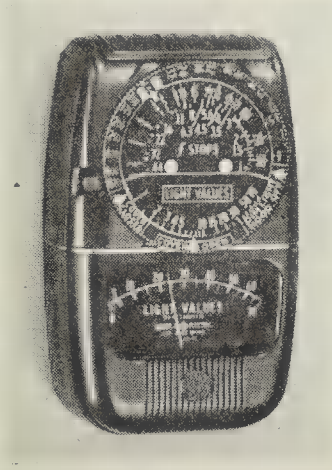
The reason lies in the fact that a camera view encompasses a variety of light intensities, which may range from very dark shadows to very bright highlights, whereas the meter is calibrated at a definite reflection factor. Therefore, because the meter encompasses more or less the same area as the camera, when held at the camera position it will take in a great deal of light from the sky, as in a landscape, and much less from the foliage, etc. The result is an "average" measurement that is of no use at all because the light from the sky will be relatively so strong that it will greatly overbalance the light coming from the foreground. As a result, the sky reading is favored and under-exposure for the landscape proper is bound to result. Similarly, in the case of a portrait outdoors, a reading from the camera position will take in the background and surroundings as well.

Book was lowered to take a reading of shadow side of face

". . . approaching the subject closely, regardless of camera position . . ."

If these are much brighter than the subject, as in the case of a sky or a sunlit wall, the portrait subject will be under-exposed; if, as in the case of a background of dark foliage, they are less brilliant than the subject, the latter may be over-exposed.

Since the objective in light measurement is to obtain a proper reading for the most important part of the subject and to allow the exposure latitude of the film to take care of the rest, it must now be clear that in order to get a well exposed landscape, or portrait, the light reflected from these



Latest in meters

subjects *alone* must be measured. This is usually accomplished by tilting the meter slightly, toward the landscape, excluding the sky, in the one instance, and approaching the portrait subject closely enough with the meter, regardless of the camera position, to include within the meter angle only the face of the person being photographed. A convenient rule for taking readings of objects at close range is to approach the subject to within a distance equal to the width of the subject.

Sometimes, however, it is not possible to approach the subject closely enough for proper reading. In such cases, the substitution method of meter measurement is used. If there is a tree or a house in the shade across the water that you want to include in a particular view, all you have to do is take a reading from your own clothing or from a tree nearby and use this reading for the exposure.

Where it is not possible to obtain a meter reading of the direct reflection from the subject, it is useful to read the incident light, that is, pointing the meter towards the light source itself. In the latest meter to appear on the market, General Electric's Type DW-48, provision is made for making readings of this type direct. A self-multiplier is incorporated in the calculator which automatically multipies exposure when the meter is used for incident light measurement in very dim light. (See "What's New" for fuller description of this meter.)

How other electric meters may be calibrated for use in reading incident light is suggested in the following experiences of C. W. Gibbs, A.R.P.S.

"In my experiments, I used the Mini Photoscop. This meter is cali-

Extreme brightness range such as this requires care in exposure

brated in American Scheiner figures. In my first trials a Kodaflector was set up exactly six feet from the subject. Two small flood bulbs were employed. The meter was held near the subject's face and pointed toward the lights. The meter reading was 9. This value was jotted down and then a series of exposures was made on Super XX film. The films were developed in X33 for the correct time to give a gamma of .7. Upon examination it was found that the exposures were fairly good through a range of from 1/250 at f/2 to 1/250 at f/5.6. Setting the meter to these exposures and then seeing what film speed was equivalent to a reading of 9 it was found that these exposures would have resulted from a setting of 17 and 26. For normal use, then, we would consider the Super XX to have a speed half way between these two values. If the light were dull or if we were compelled to shoot at a higher speed than normal, we could see by setting the film speed to 26 if we would get a good negative or if it would be thin. If the latter, we could compensate to some extent by prolonging the development time."

Any given scene may receive several different exposures, each of which will be considered correct for the result wanted, and this without regard for the general over- or under-exposure of the full image. A subject reflects highlights, shadows, and middle tones. If the brightness range is longer than the latitude of the film can take in at once, the worker has a choice of three procedures. He can read the shadows or the highlights or the middle tones and use each reading as a basis for exposure of the whole. The fact that film has a tone range from 1 to 128 is used in a practical way on the dial of the Weston exposure meter. Besides an arrow provided for normal readings, there is a letter *U* and an *O* at either end of the indicator scale on the dial. By using this meter to read

Fifth Annual Scientific American

AMATEUR PHOTOGRAPHY CONTEST

OVER $1200 IN PRIZES

IN this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules. In addition to the seven major prizes and five honorable mentions, there will be three SPECIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners. *These special awards will be given in addition to the regular prizes that the pictures win.*

36 PRIZES *PLUS* Three Special Awards

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

Division 1. Human interest, including camera studies of people, animals, and so on. Portraits will be grouped in this division.

Division 2. Landscapes, including all scenic views, seascapes, and so on.

Division 3. Action, including all types of photographs in which action is the predominating feature.

IN EACH OF THESE DIVISIONS THERE WILL BE AWARDED SEVEN MAJOR PRIZES AND FIVE HONORABLE MENTIONS. WINNERS OF THESE PRIZES BECOME AUTOMATICALLY ELIGIBLE FOR THE THREE SPECIAL AWARDS.

RULES of the CONTEST

1. The groups will be judged independently on the basis of pictorial appeal and technical excellence. The decision of the judges will be final. In case of a tie for any prize, duplicate prizes will be awarded to the tying contestants.
2. Prints must not be smaller than 5 by 7 or larger than 11 by 14 inches. All prints must be mounted, otherwise they will be returned immediately.
3. Photographs must be packed properly to protect them during transportation.
4. Non-winning entries will be returned only if sufficient postage is included when the prints are submitted.
5. Each entry must have the following data written on the back of the mount: Name and address of contestant, type of camera, and film, enlarger, and paper used.
6. Contestants may submit no more than two prints in each group, but may enter any or all groups. In no case, however, will more than one award be given to any individual contestant.
7. Prints must be in black and white. Color photographs are not eligible.
8. Prize-winning photographs will become the property of Scientific American, to be used in any manner at the discretion of the publisher.
9. Scientific American reserves the right to purchase, at regular rates, any non-winning entry.
10. No entries will be considered from professional photographers.
11. All entries in this contest must be in the hands of the judges by December 2, 1940. Results will be announced in our issue dated February, 1941.
12. The contest is open to all residents of the Western Hemisphere who are not in the employ of Scientific American.
13. In fairness to all contestants, failure to comply with any of the above rules will result in automatic disqualification.

THE PRIZES

1st. Three $125 LONGINES, Coronation Model, Solid Gold, Men's Wrist Watches.

2nd. Three $85 LONGINES, Presentation Model, Solid Gold, Men's Wrist Watches.

3rd. Three FEDERAL No. 246 Photo Enlargers (List Price $49.50).

4th. Three FEDERAL No. 345 Photo Enlargers (List Price $42.50).

5th. Three PIERCE CHRONOGRAPH Men's Wrist Watches (List Price $19.75).

6th. Three BERMAN-MEYERS Flash Guns complete with case (List price $15).

7th. Three FINK-ROSELIEVE Vaporators (List price $12.50)

HONORABLE MENTION

1st. Three Fink-Roselieve "Hi-Spot" Hollywood type spotlights.

2nd. Three Mimosa Perkino developing tanks.

3rd. Three Raygram Wood-Chrome Tripods.

4th. Three Fink-Roselieve Audible Timers.

5th. Three Fink-Roselieve Satin-Chrome Range Finders.

THREE SPECIAL AWARDS!

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest. To the contestants who entered these three photographs will be presented the following special awards:

1st. One No. 715 Weston Exposure Meter (List price $24.)
2nd. One No. 650 Weston Exposure Meter (List price $19.95.)
3rd. One No. 850 Weston Exposure Meter (List price $15.50.)

THE JUDGES:

McClelland Barclay, artist
Ivan Dmitri, artist and photographer
T. J. Maloney, editor of U. S. Camera
Robert Yarnall Richie, photographer

Address all Entries to

Photograph Contest Editor, Scientific American

24 West 40th Street New York, N. Y.

the extremes of brightness in a subject and then setting the *U* instead of the "normal" arrow, or the *O*, depending on which end of the subject brightness range is to be favored, a reasonably correct exposure will be obtained that will take advantage of the full scale of the film.

A last word. You may follow these suggestions and still go wrong. However, before you start blaming the meter, ask yourself the following questions:

1. Am I using the correct speed rating for the film?
2. Is the shutter working properly?
3. Was the resulting negative correctly developed?

Behind the Speedguns

THERE is much more to a Speedgun than may appear on the surface, as a visit to the Speedgun Corporation's plant in Bloomfield, New Jersey, has convinced us. For one thing, more than 600 separate parts are required for the assembly of the various Speedgun models. To produce these, the Speedgun engineers employ 150 special tools, one of which is a tube-cutting machine that not only saves several burring operations in cutting dural and brass tubing, but is capable of slicing two-inch tubing to lengths as short as 10/1000 of an inch. The Speedgun engineers design and make their own tools in many instances, thus making the plant independent of outside sources of supply.

The development division of the plant, under the supervision of Philip K. McGall, inventor of the Microswitch, is carrying on the work begun ten years ago by S. Mendelsohn, of the Speedgun Corporation, in developing new techniques in synchronization design. Many of the models turned out by this division are never seen by the general public, but the facts learned are incorporated in the design finally chosen for inclusion in the finished commercial product. The research is pursued not only for the sake of perfecting designs for current requirements, but also to keep a weather eye out for future needs and developments.

One of the items that will see the light of day in the near future is the Multiflector, a reflector-magazine holding six No. 5 G. E. "Mighty Midget" bulbs; these are mounted on the gun in the usual way and the lamps flashed either individually or in unison, depending on the number of switches thrown. A special carrying case holding six of these Multiflectors will be available, thus making it possible for the photographer to load 36 bulbs at once and never handle a single bulb until they have all been flashed. "On the fire" is another gun, to be known as the Superspeed, which will fire 12 flashbulbs one after the other and which can be operated either on or off the camera.

For accurate testing of shutter synchronization, a Speedgun Timer has been made available to newspaper offices and will soon be ready in sufficient quantity to be placed in centrally located agencies throughout the country. The tester works at 1/10,000 of a second and permits ready testing with every assurance of certainty as to the result.

Portraits With A Spectacle Lens

GET your optician friend to make you up a spectacle lens of a focal length your camera will accommodate, mount it in a square of cardboard of the right dimensions to fit the front of your camera, and try your hand at soft-focus portraits. The results may surprise you. The illustration is an example. Notice how the highlights spread out into the shadows and a general softness of outline prevails over the entire face. Sharp pictures are not always the best pictures, particularly in the case of portraits; a soft picture such as this may often be superior.

With a spectacle lens

Fine-Grain Developer Formula

A FINE-GRAIN formula that appeared in the older issues of the "Gevaert Formula Book" is reprinted in the current issue of the *Gevaert Sensitizer*. It consists of only metol and sodium sulfite made up as follows:

Metol .... 1/4 ounce
Sodium sulfite—
(anhydrous) .... 3 1/2 ounces
Water to make .... 32 ounces

Development is for 20 minutes at 65 degrees. Distilled water is recommended. The developer is said to keep a very long time.

National Photonews Weekly

A WEEKLY journal of news and comment concerning matters photographic and cinematographic has recently made its appearance, with headquarters in Washington, D. C. An-

nounced as "a national publication for amateur photographers," it is published every Saturday under the editorship of Don Bennett. The publication states that it "welcomes news of the activities of camera clubs and individuals and manufacturers interested in amateur photography," and asks that in submitting copy having a time element, the contributor should allow for the lapse of one week's time. The publication should be addressed: National Photonews Weekly, Editorial Office, News Building, 1013 Thirteenth Street, N. W., Washington, D. C.

Labels on Bottles

One of the most vexing darkroom problems is how to make labels stick on bottles. If some way were found to prevent sloshing water or other liquids over the label, there would be little trouble, but as this usually appears to be unavoidable, it it necessary to provide a means of protecting the label under all circumstances. A suggestion is offered by Morris Germain, A.R.P.S., that he claims has worked for him for a long time. He takes a few sheets of undeveloped glossy printing paper and, by the ordinary darkroom printing safelight, immerses it in the regular fixing bath. After the paper has been "fixed out," he turns on the white light, washes the paper in the usual way and then allows it to dry on a ferrotype tin. He then cuts the paper up into the sizes he needs and letters the paper with black waterproof ink. When the ink has dried thoroughly, he wets the paper again, squeegees out the excess water, applies ordinary library paste on the back and attaches it to the bottle. The last operation is a coating of spar varnish.

New Reflex Case

A sole leather, velvet-lined carrying case for the new Brownie Reflex Camera is being offered by United Camera Exchange of New York City.

The case follows the styling and design of similar cases made for more expensive cameras of the candid type, and features a drop front allowing full freedom for the finder and taking lens; it also has a die-cut window in the rear so that film exposure numbers can be seen as the film is wound. The cord furnished by Kodak as a part of the Brownie Reflex is used as the carrying strap.

For Nature Shooters

Shooting insects and other small creatures frequently offers obstacles because they cannot be kept in one place long enough for the necessary critical focusing (close-up lenses being required) and relatively long exposures. One worker got out of the difficulty by placing the insects in a bottle and then injecting into the bottle a small quantity of illuminating gas from the kitchen gas jet. The creatures become dulled and as a re-

sult move very slowly. It is a simple matter then for the photographer-naturalist to place the insect where he pleases and to take his time about focusing and shooting. For the information of the tender-hearted, the effect is temporary and after the gas wears off the insect moves normally again.

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WHAT'S NEW

In Photographic Equipment

Moore "Long Fellow" Enlarger ($50 without lens): Features coolness, compactness, versatility. Both enlarger and baseboard mounted on 90-inch chromium plated tubular upright. When not in use, enlarger and baseboard may be swiveled against wall. Suction ventilation of lamphouse, aided by insulation of lower condenser from body of lamphouse, results in negative being absolutely cool. There is no material rise in temperature, even if negative is left in enlarger for period of several hours without any air circulation other than that provided by enlarger itself. Enlarger employs metal sleeve bellows. Equipped with three lens boards, recessed, flat, and protruding to take all normal focal length lenses up to and including 6-inch. Employs double condenser system, 4½-inch condensers removable for cleaning. Position of light bulb adjustable. Equipped with plastic light filter for use when focusing on paper. Focusing by micrometer gear. Will take negatives 35mm to 2¼ by 3¼ inches and any 2¼ by 3¼-inch portions of negatives up to 11 by 14 inches. Wooden baseboard, crack-proof, warp-proof, measuring 20 by 30 inches, may be rotated through 360 degrees, vertically or horizontally, allowing for any desired distortion or correction. Two brackets furnished with 90-inch upright for attaching to side wall or floor and ceiling. Regular table model also available called "Short Fellow" ($40 without lens).

Brownie Reflex ($5.25): Miniature twin-lens reflex camera for beginner. Large, brilliant, efficiently hooded reflex view finder; image remains visible during exposure. Takes 12 pictures 1⅝ inches square on No. 127 roll. Size of camera: 4¾ inches high; 3 1/3 inches wide; 2¼ inches through. Compact design without projecting fittings. Automatic self-cocking shutter with bulb and instantaneous settings, and plunger-type release. Lens good quality meniscus of correct speed for daylight snapshots, as well as snapshots at night with high-speed film and Photoflood set-up. Fixed focus.

General Electric Type DW-48 Exposure Meter ($21): One-hand operation made possible by special calculator arrangement; spring-actuated hinged cover, new locking device. Meter calibrated to measure

light in standard foot-candles. By means of incident light and hinged cover, single scale on meter covers range of sensitivity from 0.05 to 1700 candles per square foot. New feature permits locking calculator after reading is taken so that calculator adjustments will not change if meter is put in case or pocket. Other features: simplified calculator for still, color, and movies; self-multiplier on calculator which automatically multiplies exposure when meter is used for incident light measurement; film values up to 800; F stops from $f/1$ to $f/44$ and shutter speeds from 1/2500 of a second to 100 seconds. Accompanying each meter is 110-page data book giving film values, filter factors, Photoflood and Photoflash data, paper speeds, and formulas.

RECOR FRESHMAN PHOTOGRAPHIC KIT ($11.95): Outfit includes camera, enlarger, rolls of film, roll-film developing tank and all necessary darkroom accessories: chemicals, enlarging paper, film safelight, thermometer, film clips, trays, and so on. Manufacturer says: "While primarily designed for the youngster and beginner in photography, it will also appeal to the more serious minded worker as providing a practical groundwork in the fascinating hobby of photography."

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THE ROUND TABLE

Questions Answered for the Amateur Photographer

Q. **I am planning to make an enlarger. My largest size negative will be 2¼ by 3¼ inches. In consulting a table I find a 4½-inch focal length lens requires a distance of 6¾ inches from negative to lens for a two-times enlargement. Could I use a single extension camera (4⅛-inch focal length) for the lens and bellows by fitting a light-tight box on the back of the camera?—C. R. W.**

A. The arrangement you suggest sounds practical enough because you will have sufficient leeway in your bellows for the necessary adjustment for a wide range of magnifications. It is important, of course, that the box you construct fits snugly over the back of the camera and permits no light to escape around the connecting edges.

Q. **Where or from whom could I get specifications on the many lenses that are on the market for the miniature enthusiast to choose from? Details I want to get include the type class of the lens, good characteristics and limitations, diameter of circle of confusion, degree of color correction, method of focusing, size of plate covered at full and at reduced aperture, and so on. Such a jumble of names (Ektar, Cintar, Triotar, Tricor, Elmar, Hektor, Zenor, Hypar, Dagor, etc.) means so little to me.—W. L.**

A. Some of your questions are answered in scattered sources, but we

do not know of any one complete reference where information such as you want may be obtained. However, the individual manufacturers or distributors are always glad to supply such information on request. Their addresses can be obtained from magazine advertisements or from your regular photographic dealer.

Q. **Enclosed are a couple of vest-pocket size negatives and a couple of commercial prints. I know the composition isn't so hot and the lighting is terrible, so don't bother to card me out about that. However, a strong magnifier on the negatives shows a lot of detail that does not show up in the prints. Now the question: Could an old bird like me (fiddling with cameras for forty-odd years) do any better if he got a hundred dollars' worth of equipment and spent his spare time in the cellar? Is there any likelihood of better results if I were to do the work myself instead of sending them to a finishing plant?—H. A. H.**

A. That depends on the plant to which you send your films. Some of them are first rate. In general, however, you could probably do much better in many instances because you would be able to give the work more time. The negatives you enclose seem rather contrasty and should have been developed in a soft-working developer because of the contrasty lighting employed. You would know this and would be willing to use the proper developer for the type of exposures made. This is one great advantage of doing the work yourself. As for the prints, a softer paper might have helped matters some. In general, it is far better that the serious worker do the processing himself. The results will be more satisfying because the worker will be able to give each print the care and attention that the average finishing plant does not have the time for; the prices they get would not justify the effort.

Q. **I have a Contax III with a f/1.5 lens. Can I use it in an enlarger of the Kodak type?—Dr. H. D.**

A. We do not know which of the Kodak miniature enlargers you have reference to, but, provided it will accommodate a 2-inch lens, you should be able to adapt it to the enlarger. Of course, a special lens flange will be required.

Q. **I have a 2¼ x 3¼ Speed Graphic and I use an Abbey battery case and reflector for the built-in focal plane synchronizer, with Press 40,000 flash bulbs. I shoot at 1/225 at f/8 and the exposures are perfect, but when I drop the exposure down to around 1/100 the density begins to fall off at the bottom of the negative.—M. K.**

A. The Press 40,000 bulbs should not be used with shutter speeds slower than 1/200th second, according to the advice of the manufacturers. This speed—or greater—permits the focal plane shutter to traverse the film while the light is at its peak.

YOUR FIREARMS and FISHING TACKLE

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; fishing tackle is a requisite of one of the world's oldest occupations. Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department which welcomes correspondence from readers.*

It's Called "Targo"

SOME will nick-name it "back-yard skeet," some may call it "vest-pocket trap," but the Mossbergs have termed their latest innovation "Targo," and all who try it will sing its praises from the standpoint of good gun fun and excellent wing shooting practice. The best part of the story is that, following their principle of providing shooting enjoyment for more people through good equipment at moderate prices, O. F. Mossberg & Sons, Inc., have arranged to offer their new combination gun-and-trap, together with miniature pigeons to be used with .22 caliber long-rifle scatter shot shells for indulging in the sport of "Targo" at so nominal a figure as to make the game available to all. For less than $25 you can own the gun, the trap, and even a net to save undusted pigeons from breakage when they hit the ground. Your operating costs will be equally low, for the .22-caliber shot shells can be had for 50 to 60 cents per box of 50 and the clay birds will be much less than one cent apiece.

Loading

Cocking

The Mossberg Model 42 TR "Targo" gun is in reality two guns in one, for each comes with what is known as a "Rifle Adapter Tube." This is a rifled section of .22 caliber barrel, 5 inches long, which replaces a length of "Targo" gun smooth-bore barrel, and which, by an ingenious new method of rifling, converts the "Targo" gun into a .22 rifle which is claimed to be as accurate as though rifled throughout. Furthermore, there is a 7-shell capacity clip in the forearm below the chamber which makes a bolt action repeater out of the gun, shooting any standard .22-caliber solid ammunition.

"The Targo" gun is built on the Mossberg "Master" action, walnut finish stock with molded trigger guard with finger grooves and molded buttplate. It is 43½ inches long, weighs about 5¼ pounds and balances nicely with or without the trap. It has a 22-inch round, smooth-bore barrel, and when fitted with the 8-inch "Targo" tube equipped with a special choke ring to prevent the shot from balling and coming out as slugs, it gives a nice, even pattern.

The "Targo Trap" weighs 14 ounces, is attached to the barrel just ahead of the forearm, is easily removed and will fit almost any single barrel .22-caliber smooth bore or .410 bore shotgun. The trap cocks effortlessly, is released by the fore finger of the left hand while the gun is at either skeet or shoulder position. The swing of the trap as it throws the "bird" is not sufficient to produce an appreciable sideways recoil in the gun. To the contrary, the backward thrust is scarcely noticeable as the target sails through the air in any direction desired by the shooter, and it will be at once understandable that the variety of angle shots possible are almost legion. An adjustment on the spring permits you to vary the flight of the targets, making the shooting easy or difficult, as you like.

The "Targo" targets are ½ normal size, will break on impact of the tiny .22-caliber pellets up to 50 feet, and are packed in lots of 200 in special break-proof cartons developed by Mossberg. When the Mossbergs say "break-proof," they mean it. During a recent visit to the factory, Walter Pierson told us of some of the tests to which target-loaded cartons had been subjected. They threw the packed cartons down the factory stairs, pushed them out the window, dumped them off fast moving trucks and generally kicked the poor things all over the lot. Even when they finally found a packing method which enabled the targets to survive such blitzkriegish treatment, they weren't

Releasing

satisfied. When you receive your first carton of "Targo" targets, you'll find a few extra for good measure and as a sort of "just-in-case" precaution. Furthermore, five unbreakable targets, made of rubber, are a part of each "Targo" trap outfit. These are used in distance and direction experiments with the trap, thereby saving a lot of clay pigeons.

The "Targo" net, insurance against ground-smashed pigeons, is 20 feet square, is easily set up on 6-foot posts and has a mesh fine enough to catch

"Targo" birds and shells

and save undusted birds, but large enough and sufficiently flexible to permit the netted targets to be drawn through the net from below. With or without the net, "Targo" is a new sport to be enjoyed just about any place, including an open field, the golf or gun club, or even a large back yard. The 120 to 130 pellets of a scatter shot .22-caliber shell are very tiny and are unlikely to cause damage when properly used, but as it still takes only one pellet to ruin an eye, don't forget the tried and true Commandment of Safety, "Never point a gun at anything you do not want to shoot." All-in-all, we believe "Targo" has unlimited possibilities for fun and helpful firearms practice. Want a "Targo" booklet?

Clean Barrels Shoot Better

IT'S a strange indictment against the gunning fraternity that about 98 percent of the enormous annual repair bill for guns is traceable to the owner's neglect. The introduction of non-corrosive ammunition led not a few to the belief that, save for an occasional patch and oil, the barrel cleaning chore was a thing of the past. True, non-corrosive shells will not rust the tubes, but they are primarily intended to knock over game or skeet targets, not to *prevent* rust. Likewise, the little problem of leading is still with us, and for some reason scattergun owners seem more prone than riflemen to rely only on oils, greases, and rags to remove lead, perhaps on the theory that the new powders fired through a clean bore with no rifling eliminate the necessity of this operation.

In view of the extensive array of shotgun cleaning agents available, all at a very nominal cost, there is really no reason why shotgun barrels should not receive the best of care with the result that patterns will be improved, kills will be cleaner, and the gun will last longer. As every gunner knows, lead in barrels retards and mutilates the pellets, causing them to sheer away from their normal flight and ruin an otherwise effective pattern.

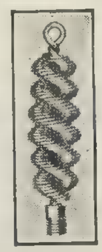
Not long ago we mentioned a new shotgun cleaning device known as the "Ferret Cleaner," and we have since observed that it has met with widespread approval from scattergun men. Like other tube-scouring implements, the Ferret is designed to remove lead deposits, and not to be used to the exclusion of a good oil, or grease, and a rag. But, unlike the old style wire bristles, the Ferret "shaves" the lead from the barrels instead of brushing it off, often a not too effective process.

Composed of flat, bronze alloy wire, soft enough to prevent gun barrel injury yet hard enough to get at the lead, the Ferret is tapered at both ends to permit passing through the choke in both directions, either on the cleaning rod or on a stout cord. It is self-sharpening and works even better after having been used a few times. As the coiled, flat wires are formed into a tapered, cylindrical shape, it is unnecessary to impart a revolving or rotating motion to the rod when running it through the barrel.

A recent letter from T. R. Walker, of The Dairy Specialties, Inc., manufacturers of the Ferret, stated: "Since we have been making Ferret cleaners we have been surprised to find that many men who have used guns for years do not realize that they have lead in their gun barrels. When they clean their guns with a wire brush and patches, they polish up the lead until the gun looks clean. Then, when a Ferret is run through, and they see the amount of lead which is removed by the bronze wires, they are unable to believe their eyes." All we can add is that we continue to use a good grade of oil for cleaning and lubricating, that we "Ferret our guns" religiously after shooting and that we believe the combination provides good insurance for longer lasting firearms and few, if any, repair bills resulting from neglect of our guns.

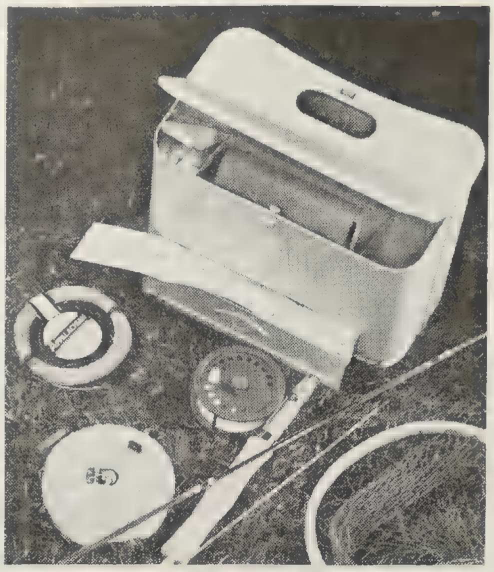
Aluminum Creels

WE'VE often wondered why someone didn't make a creel of aluminum, and now along comes Messrs. Smith & Focht with their "Ideal Creel," which appears to us to be very well named, indeed. Weighing but a few ounces more than our old reed



basket, the "Ideal" is 12 inches long, 8¼ inches high in back, 6-1/4 inches high in front, and 6 inches wide. It is extremely durable and the sprayed, brushed aluminum finish not only gives the creel an attractive appearance, but also prevents sun flash.

Best of all, to our notion, is the conversion of hitherto waste and useless space into additional convenient



"Ideal" for stream anglers

storage places for important items for the stream angler. Besides the well-ventilated fish compartment accommodating eight pounds of fish and equipped with drainage openings which will not drain on the user's clothing, there is a tackle compartment. This has spaces for fly books, leader box, fly oil, line dressing, skeeter dope and a built-in, removable bait box. There is also a drawer for sinkers, hooks, leaders, minnow rig, and other small items. Inasmuch as we're one of those fishermen who isn't happy unless he can lug along everything but the kitchen sink, and as we've wished often for a place to carry our camera, we think we're going to like the Smith & Focht "Ideal Creel." Would you like a descriptive folder?

POT-SHOTS
At Things New

STOEGER ARMS CORPORATION has just brought out its latest publication, an attractive 24-page book entitled, "Stoeger Gun Stock Guide." It offers complete information concerning remodelings, gunsmith specialty tools, Peerless actions and barrels, Peerless remodeling of military and sporting rifles, American and French walnut stock blanks, blueing equipment, standard targets, and many other items of interest to the amateur gunsmith. This new book is not to be confused with the annual "Shooters Bible," published yearly by The House of Stoeger, for the new one stresses tools and materials for remodeling and other gunsmithing activities. For more than 50 years A. F. Stoeger, Founder and President of Stoeger Arms Corporation, has been widely known for his helpful service in connection with American and imported guns and accessories. Long an expert gunsmith himself, he subscribes to the school of thought that every gun owner should intimately know each part of his gun and how to care for it.

FEDERAL CARTRIDGE CORPORATION offers new wadless crimp shotgun shells in trap and skeet loads only, in 12, 16, and 20 gage. An increased number of folds in the crimp tends to reduce initial pressure and prevent deformation of pellets. All well-known good points of Federal loads have been retained in new shells, including hot, snappy primer; locked-in base; cone-shaped base wad; reasonably soft, tough paper case; "old reliable" hair-felt cushion wads; clean, bright, uniform shot. Federal also offers new rifled slug loads for shotgun use in 12, 16, and 20 gage, and .410 bore. Likewise new are 28-gage loads in 2⅞-inch hi-brass cases, with numbers 4, 6, 7½ chilled shot, and in skeet loads with number 9 chilled shot.

REMINGTON ARMS COMPANY offers new, soft point "CoreLokt" bullet equipped with notched jacket tip, which controls mushrooming, provides uniform expansion and makes it readily recognizable. Heavier base of jacket prevents disintegration, locks lead core, retains compact mass of non-disintegrating bullet to full depth of penetration and energy. The "Core-Lokt" soft point starts mushrooming

"Core-Lokt," showing notches and expansion; also vise test

immediately, expands to approximately twice original caliber at hunting ranges, retains same ballistics as regular soft point bullets in comparable weights. Simple pressure test in ordinary vise shows how special notching of jacket provides directional spreading lines for perfect expansion. The "Core-Lokt" soft point costs no more than ordinary soft points, is available in 14 sizes: .25 Remington; .25/35; .30/30 (2 bullet wgts.); .30 Remington; .30/40 (2 bullet wgts.); .30/06 (2 bullet wgts.); .300 Savage; .303 Savage; .32 Special; .32 Remington; .35 Remington.

FLASH!! — Colt's Patent Firearms Manufacturing Company have just sent word that the long-awaited "History of Colt Revolvers" by Charles T. Haven and Frank A. Belden is on the press and will be ready September 1st. This 700-page volume with 500 illustrations, handsomely bound with embossed cover, will prove a reservoir of information of daily value to every collector and lover of firearms.

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for.

EXTRA - SENSORY PERCEPTION AFTER SIXTY YEARS

By J. B. Rhine, J. G. Pratt, Burke M. Smith, Charles E. Stewart, and Joseph A. Greenwood

At last there is a complete account of the research conducted to date on extra-sensory perception (thought reading, telepathy, clairvoyance), all the important scattered data having been brought together here within two covers. This book is a summary of what has been achieved so far, a reference work covering the field as a whole, a treatment of all the evidence, a guide to the literature of the subject, a condensation of the greater bulk of it, and a handbook of methods. It includes a digest of 56 articles of criticism of experiments in extra-sensory perception, mainly as made by psychologists, in which these are dealt with without emotion or heat; in fact, the whole work is characterized by a commendable kind of calm, in view of the degree of superheat that has been connected with the subject. This book is a solid, serious study; there is nothing fluffy about it, but it is not heavy. The parts involving mathematical analysis are sequestered in 21 appendices, for readers who yearn to delve. (463 pages, 5½ by 8½ inches, eight illustrations.)—$2.85 postpaid.—*A. G. I.*

SCIENCE FRONT 1939

By F. Sherwood Taylor, Ph. D.

Chapters on science and plant growth, chemotherapy, sex and the steroids, the stuff of life, cancer, shock treatment for schizophrenia, making oil from coal, television, liquid helium, inside the atom, quartz clock, polar aurora, our view of the universe, together make up this most readable review of recent science—much of it, not quite so recent, however, as 1939. (301 pages, 4¾ by 7¼ inches, 52 illustrations).—$2.60 postpaid.—*A. G. I.*

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By H. G. Tapply

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By Carleton Ellis

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By Raymond F. Yates

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them are given in both word and picture. Indeed, the book is extremely well illustrated with plates showing finished work of all kinds and hundreds of design types, symbolisms, and conventionalizations. (289 pages, 6½ by 9½ inches.)—$4.10 postpaid. —*F. D. M.*

GETTING MORE OUT OF LIFE

By Joseph Jastrow, Ph.D., LL.D.

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TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

MONKS, like thousands of other mortals, are now making their own telescopes. From the Society of the Divine Word, Techny, Illinois, comes the following:

"Even in the crowded curriculum of studies at St. Mary's Major Seminary, astronomy has its place and holds an attraction for many a student. Its study serves a definitely practical purpose, since most of the seminarians will one day labor in foreign mission fields, where astronomical knowledge will supply in many ways what these primitive countries do not—aids in regard to time, in regard to nautical determinations, in surveying, and in exploration, to mention but a few.

Figure 1: Astronomy class, St. Mary's

"A few years ago an observatory (Figure 1) was built at Techny, housing a 110 mm. refractor, a comet-seeker, the structure having been designed and constructed by the Brother Monks. But this telescope soon proved inadequate for the interest and enthusiasm of the star-gazers, and it was deemed advisable to construct a larger one, 8" in aperture, the work being done under the direction of Father Francis Neuhaus, S. V. D., one of the seminarians. Meanwhile, Brother Corsinus, S. V. D., an able mechanic, was busy constructing a well-balanced mounting, shown in the center. With a surprising minimum of cost, the reflector was completed, and now serves to great advantage, not only to bring more of the heavens within grasp, so to say, of the students of astronomy, but also to render celestial photography possible because of the new telescope's greater light-gathering power.

"Work on a 12½" mirror for a still larger telescope is now under way."

AMATEUR telescopticians, ten or twenty thousands of them, have now felt their way into about all the related arteries and capillaries of optics and astronomy. One such ramification is sun-dialling, and under sun-dialling come sun-clocks. Just what is a sun-clock?

Invented by W. E. Cooke, government astronomer of New South Wales, Australia, the sun-clock was described in this magazine in August, 1928, also August, 1935, by R. W. Porter. A ring, or sometimes a C-shaped portion of a ring (Figure 2), carries a lens on the sunward side, and on the other an analemma, the familiar 8-shaped curve of the equation of time. By turning a thumbnut with the fingers, until the Sun's image falls exactly on the analemma, hands taken from an ordinary clock are mechanically actuated through gear trains and the standard time is read on the clock dial—direct and not by a shadow, as in a sun-dial. There is, of course, no running clock *movement.*

Working from the articles by Porter, cited above, Fred Ferson, 414 Reynoir Street, Biloxi, Mississippi, has made the sun-clock shown in Figure 3, and states that "careful construction and adjustment afford time within one minute, likewise the date. The base casting has four leveling screws and carries a second casting which supports in a curved slot a short, stubby, curved main standing arm. This can be slid circularly and clamped for latitude. At the end of this stubby arm is a rigid, hollow stud carrying the gear box and clock face and big, curved, rotatable fork. The fork has in its upper horn a slot in which is mounted a little lens of 8" *f.l.* The analemma is inscribed on a sheet brass plate bent to a radius equal to the *f.l.* of the lens (its radius of curvature is therefore nearly twice that of the fork—study Figure 7 if "nearly" is not at first clear) and attached to the lower horn. To find the time at any desired moment the large thumbnut extending, in Figure 3, below and to the left of the gear box is turned with the fingers, and gears with ratio 1, 2, and 24 do the rest; that is, 24 revolutions of the handwheel will rotate the minute hand 24 times, the hour hand twice, and the fork once. When the Sun's image is made to bisect the analemma curve the clock hands will automatically point to the hour and minute, also giving the date." Ferson will lend further details of construction to those seriously interested.

Figure 2: Porter, sun-clock

Figure 3: Ferson's sun-clock

Even now, more than a decade after he made his first sun-clock (Figure 2), Porter still composes new variations on the original theme and then makes the clocks. Figure 4 is one of these, as set up in his door-yard at Pasadena. "It consists," he writes, "first, of a spherical Pyrex flask carrying all the optical parts and the clock face, on which is also engraved the analemma. The entire unit is encircled by a grooved equatorial ring sliding on a segment below, which is fastened to the base. The equatorial gear used was a 32-pitch rack bent to fit the groove of the equatorial ring.

"In adjusting the polar axis parallel to that of the Earth, a tubeless telescope, consisting of an eyepiece and objective, is fastened to the sphere at the poles of the encircling equatorial ring. The field of view of the eyepiece contains just the apparent orbit of Polaris about the true pole; so that, by estimating the hour angle of Polaris by the stars in the Big Dipper and Cassiopeia, and using the base

screws, the polar axis of the instrument can be directly fixed.

"I find that the time can be relied on well within one minute. The glass flask was resorted to in order to protect all essential parts from the birds, who seemed to feel that I had made a gadget for their special benefit. The neck of the flask and a part of the sphere were removed with a 'biscuit cutter' (simply a cylinder of sheet metal) and abrasive. The plate of the clock, having nearly twice the radius of the sphere, was spun to its required curvature. All the machining was done on a wood-working lathe and drill press in the pattern shop here at The California Institute of Technology. Figure 5 is a photograph of another spherical globe sun-clock made earlier and partly similar."

And still another! Some months after the above descriptions were received, there arrived from Porter a note (Figure 6) and the following description "The clock to be described is about my tenth design and its performance has been so satisfactory that

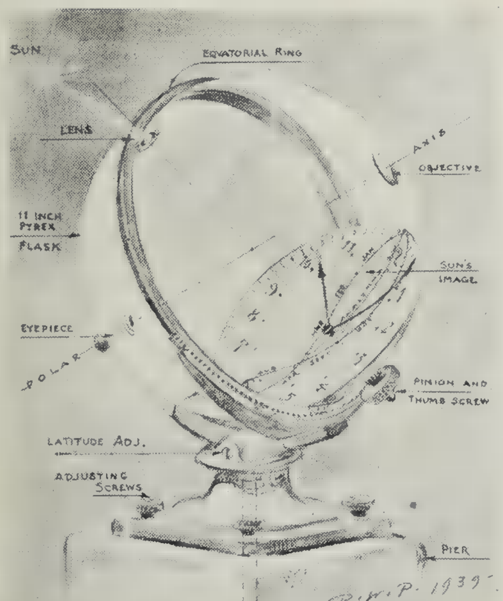


Figure 4: The bird fooler clock

I have decided to call it quits and turn the information over to those who may wish to have a gadget in their gardens demonstrating an interesting problem in celestial mechanics.

"The drawing (Figure 7) is a meridian section through the instrument and for economy of space I have inserted, or superposed, the clock face in the central area, but its true position is shown in Figure 8.

"*A* is a 12-liter Pyrex flask (Corning Glass Works—it cost $3.50), whose neck *B* has been removed with a biscuit cutter. The flask is remarkably spherical.

"To this sphere are attached the lens *C* and the brass strip *D* on which is pasted the analemma.

"In the space removed by the biscuit cutter is the clock dial *E*, carrying a minute hand. Behind the clock face is a reduction gear box operated by the thumbnut *F*. Only two pairs of stock, 32-pitch spur gears (Boston Gear Works, Cat. No. 1-G 159, 161, 177, 179) are necessary to make the minute hand revolve 24 times during

one revolution of the sphere. This clock and the gear case are fixed rigidly to the base ring H, supported on three adjusting screws I, I, I, 120° apart, and these screws rest in a circular groove cut into the plate J which, in turn, is securely fastened to the pier.

"The polar axis L of the instrument is created and maintained by the glass sphere resting in ring H and revolving around the stud M by means of a pin N engaging a slot in the sphere. To save an extra pair of gears for the hour hand, this pin N serves equally well to indicate the hour. The stud M has an inclination to ring H (horizon) equal to the latitude of the location, shown here as 40°.

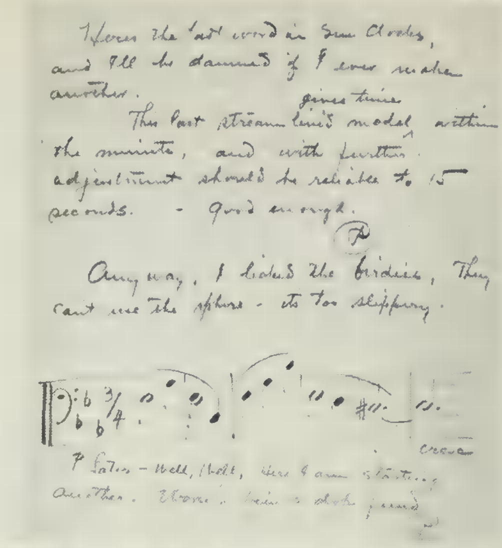
"In operation, by turning the thumbnut, the sphere is rotated until the Sun's image falls on (and bisects) the analemma, and standard watch time is taken directly from the clock face. A small portion of the analemma is shown at O, with the Sun's image as it would fall on the 15th of May, the portion opposite covering July and August. Should the image be made to fall on the center line at P, the clock would read apparent or sun time. But PO happens to be the equation of time, so that, by using the analemma, standard time is obtained automatically. Furthermore, any deviation of the observer's position east or west of the central line of the time zone in which he resides is corrected by resetting the minute hand. This is, of course, a constant.

Figure 5: Another similar type

"The analemma is marked off in five-day intervals, so that the day of the year is given, as well as the hour and minute. It is easily drawn from data in the nautical almanac.

"I have found that the best illumination of the Sun's image is produced by an f/80-or-90 lens. In the clock here described the focal length is 10" and the lens ⅛" in diameter.

"Adjusting is done with a small temporary telescope, as previously mentioned. By using the three adjusting screws I, Polaris may be brought to the required hour angle (see Q in upper, left hand corner). The telescope is removed (next day) and replaced by the sphere and clock unit.



Here's the last word in Sun Clocks, and I'll be damned if I ever make another.

This last streamlined model gives time within the minute, and with further adjustment should be reliable to 15 seconds. - Good enough.

P

Anyway, I licked the birdies, They can't use the sphere - its too slippery.

P. S. later - Well, Well, here I am starting another.

Figure 6: An addict's confession

"Finally, so that the instrument may be removed and taken indoors at any time and replaced without disturbing its alinement, a positioning stop R is provided, which is simply a strip screwed to J and against which the south adjusting screw rests."

The above description of a sun-clock, by Porter, is more detailed than those in the earlier, 1928 and 1935, articles referred to farther back, hence the would-be maker will not gain by hunting them up. An enlarged photostat of Figure 7 is available, for a small sum, from the editor.

Builders of such things as sun-clocks will occasionally hear this objection: "What real, practical good or use is the thing, when we all own watches?" To a man having that type of mind a sun-clock is no good at all, and one suggested answer is simply, "None." This should stall him, completely. To other types, however, such a thing is not only a pretty thing to own, but it visibly and tangibly demonstrates our precise knowledge of the Earth's motions in space, and thus the value is mainly intellectual.

If this nation is dragged into a war, facts stated by Carl L. Bausch, of the Bausch and Lomb Optical Co., Rochester, N. Y., in an article on "Optics and Defense," in the May-June, 1940, number of *Army Ordnance* (Mills Bldg., Washington, D. C.), may interest readers of this department.

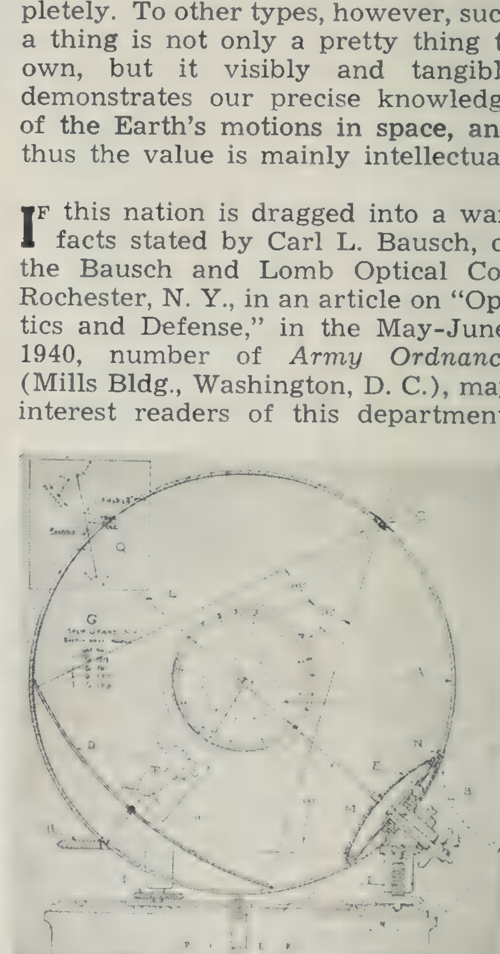


Figure 7: Porter's final (?) job

Mr. Bausch states that "Bausch & Lomb is now making 24 types of optical glass . . . . The present monthly capacity is about 10,000 pounds per month . . . . Practically all materials now used in glass making come from domestic sources, with the exception of nitrates which come from Chile in their crude form and are purified here . . . . The choke point in glass making is no longer the procurement of sufficient and suitable melting pots. The bottleneck has been transferred from the manufacture of glass to the manufacture of optical parts and to the assembly and adjustment of the instruments . . . . We could increase the output of our instrument plant five times in dollars-and-cents value of product in the first three years of an emergency . . . . It would be necessary to work three 8-hour shifts or, preferably, two 10- or 12-hour shifts. We would have to add 4000 more employees to our payroll . . . . During the recent years of depression, mechanics have not been trained as they were previously, and I think it is safe to say that the available supply of trained mechanics today is less than

Figure 8: The same as Figure 7

it was in 1917 . . . . Without skilled labor available, it will be necessary to recruit younger employees into our organizations to increase production, as young workers learn a new job much faster than mature ones . . . . These (the 4000 new employees) will be divided as follows: Glass plant 200; optical parts work 1000; manufacture of mechanical parts 1000; assembling and adjusting 1500; toolmakers, etc., 300."

Asked whether amateur opticians, such as read the present pages, could be used, Mr. Bausch replied: "We already have a couple men in our precision optics division who came through the amateur telescope makers' channel. We believe, everything else being equal, that a man who has had experience in making reflectors for his own use will be more valuable to us as an optician than one who has not had a try at it."

On to Rochester, you am-optical patriots—in case Uncle Sam fights!

STELLAFANE convention, Saturday, August 10. Porter coming.

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

A Reminder

IMPORTANT changes in the Patent Law become effective on August 5, 1940. After that date an application for a patent cannot be filed more than one year after the invention has been made public either by being described in a printed publication or by being publicly used or sold. Prior to this change applications for patents could be filed within two years after an invention has been made public. Another change in the law, forming a corollary to the above change, provides that claims cannot be copied from issued patents for interference purposes more than one year after the granting of the patent.

Loop Hole

THE Federal Trade Commission is not empowered to restrain unfair methods of competition or unfair and deceptive practices in intra-state commerce even though the unfair practices adversely affect interstate commerce, according to a recent decision of a Federal Circuit Court of Appeals.

The Commission had instituted proceedings against a candy manufacturer charging him with using or promoting a lottery in connection with the sale of its candy. The manufacturer sold assortments of candy to dealers. In each assortment there were candies having differently colored centers and the purchaser of these candies was entitled to receive, free of charge, a larger piece of candy.

In a prior case the United States Supreme Court had sustained the contention of the Commission that the sale of candy assortments of this type constitute an unfair method of competition and upheld the power of the Commission to restrain such sales in interstate commerce. In the present case the manufacturer confined his sales of the candy assortments to the state in which he was domiciled. Under the circumstances the unfair method of competition did not take place in interstate commerce.

The Commission proved that the candy assortments were sold in competition with the product of other manufacturers who were engaged in interstate commerce and it was contended that the unfair method of competition in question adversely affected interstate commerce. The Commission argued that it was empowered to protect the interstate commerce of the competing manufacturers by restraining the unfair methods of competition of the manufacturer proceeded against, even though these methods were employed solely in intra-state commerce.

The Court fully considered the contention of the Commissioner and did not deny that the unfair methods of competition adversely affected interstate commerce. It concluded, however, that the powers of the Commission were limited by the Federal Trade Commission Act to restraining unfair practices in interstate commerce. In this connection the Court stated:

"The only practices with which the Commission may concern itself are transactions in interstate commerce. The Commission's authority is to be found in the act which created it, as amended. The purpose of the act was to supplement the Sherman Anti-Trust Act, * * * and to prohibit practices which were unfair and destructive of competition in interstate commerce."

Doubtful

A PATENT interference is a proceeding in the Patent Office to determine which of several contending parties is the first inventor and as such is entitled to receive a patent for the invention. The usual interference involves two or more applications for patents. However, at times an interference involves a patent and one or more patent applications. When the interference is between applications for patents the burden of proof of the junior party—that is, the last party to file an application—is the same as in an ordinary civil suit and it is only necessary for the junior party to prove priority of invention by a preponderance of evidence. However, when the interference is between an issued patent and a patent application filed subsequent to the issuance of the patent, the burden of proof of the junior party is the same as in a criminal case—namely, the junior party must prove priority of invention beyond all reasonable doubt.

The importance of this distinction is illustrated by a recent interference involving a patent and a patent application. The proof of the junior party in the interference in question depended to a great extent upon oral testimony and upon certain drawings. The drawings contained additions and changes and the witnesses were unable to state exactly when the additions and changes were made. The Court stated that the witnesses were

unquestionably men of good character but pointed out that there were certain weaknesses in the evidence—namely, the original model or device embodying the invention could not be found and was not produced and the drawings relied on admittedly included changes and additions. Under the circumstances, the Court concluded that there was at least a reasonable doubt that the junior party was the first inventor and on this basis awarded priority of invention to the owner of the patent. In reaching its decision the Court made the interesting comment that if the junior party were only required to prove his case by a preponderance of evidence then they would be justified in deciding in favor of the junior party.

Paper Rolls

A PATENT for an improved press roll in a paper-making machine was held to be valid and infringed in a recent suit in the federal courts. The patent related to a press roll made of crushed or ground stone held in a binder of vulcanized rubber. Prior to the patent, press rolls in paper-making machines were made of iron, wood, various alloys such as brass, and also granite. The Court found that each of the materials previously employed in press rolls gave rise to difficulties. Thus the granite was too heavy, the brass would score and damage the paper, and the wood would crack.

The Court found that the patented roll solved the problems presented by the rolls previously used and concluded that the patent was valid. In an attempt to invalidate the patent the infringer cited certain earlier patents relating to rolls used in fruit presses and clothes wringers. The Court refused to consider these patents on the grounds that they related to a remote and non-analagous art.

Unprotected Panties

IN a case of human interest—but one which will certainly not affect the destinies of the world—a Federal Court held that a copyright cannot be obtained for a pair of rubber panties. Suit was brought for infringement of a copyright relating to a folded greeting card containing the representation of a traveling bag on the outside and a pair of rubber panties pasted on the inside. The defendant's card differed from the copyrighted card in details but was similar in essentials. The Court found that there was nothing new in the representation of a bag on the outside of the card and that this feature was not protected by the copyright. The Court also held that there was nothing "of literary or artistic production in the pants, any more than in a cigar or a safety pin attached to a card" and concluded from this that the panties were not subject to copyright protection under our laws.

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

TRADE MARKS, LAW AND PRACTICE OF, is a copyrighted reprint, in 24-page booklet form, of an address before the New York County Lawyer's Association. The discussion details the problems of trade mark selection, protection, and use—what can and what cannot be used, protected, and why. *Sylvester J. Liddy, 24 West 40th Street, New York, N. Y.—Gratis.*

AGFA FORMULAS FOR PHOTOGRAPHIC USE (revised edition)is a 32-page booklet including more than 45 formulas which have general photographic application. The booklet lists formulas for developing, fixing, shortstop, toning, reducing, intensifying, and desensitizing solutions. A valuable section is devoted to a detailed but simple description of the chemistry of development, with new information on developer exhaustion and time-temperature compensation. *Agfa Ansco, Binghamton, New York, or through photographic dealers.—10 cents.*

ARTIFICIAL LIGHT AND ITS APPLICATION is a 296-page spiral bound book which gives up-to-date information on the latest lighting practice. It was written by experts, in clear and comprehensive manner, for lighting engineers, students, and laymen. Over 400 illustrations are used to show recent developments in fluorescent, electrical discharge, and incandescent light sources. *Advertising and Sales Promotion Department, Westinghouse Lamp Division, Westinghouse Electric and Manufacturing Company, 150 Broadway, New York, New York. —$1.25.*

USE AND ABUSE OF WOOD IN HOUSE CONSTRUCTION, Miscellaneous Publication No. 358, is a 24-page thoroughly illustrated booklet which will be of interest to present and prospective home owners. It presents practical facts regarding wood in building construction, accompanied by a large number of photographs. It covers the entire subject from cellar to shingles. *Superintendent of Documents, Washington, D. C.—10 cents (coin.)*

VENETIAN BLIND MANUAL is a 24-page illustrated catalog that presents specifications, standards, and design data on venetian blinds and their installation. It deals with both wood and metal blinds. *Chicago Venetian Blind Company, Michigan at 39th Street, Chicago, Illinois.—Gratis.*

PHOTOELECTRIC ANALYTICAL METHODS is a 24-page bulletin which contains abstracts of a large number of recently published technical descriptions. The exact details are given for the applications of these methods with one particular type of Photometer. *Wilkins-Anderson Company, 111 North Canal Street, Chicago, Illinois.—Gratis.*

HOW TO CUT COSTS AND INCREASE PROFITS is a saw manual edited for those whose work involves production processes which necessitate the use of saws. It is specifically concerned with the "Speedmatic" saw for use in building, shipping, maintenance, manufacturing, and so on. This saw is a high-speed, power-driven, but hand-guided, portable device. *Porter-Cable Machine Company, Syracuse, New York.—Gratis.*

PATTERSON PEBBLE AND BALL MILLS is a 32-page illustrated catalog of high-grade machines for use in the fine-grinding field. A large number of types are illustrated and described and their uses are dealt with briefly but clearly. *Patterson Foundry and Machine Company, East Liverpool Ohio.—Gratis.*

ROADSIDE DEVELOPMENT is a 64-page typewritten report of the Joint Committee of the Highway Research Board and American Association of State Highway Officials. It deals largely with the work which is being done to beautify highways in the United States and to protect them both functionally and in relation to adjacent land use. It takes up such matters as zoning of roadside businesses, the limited use of roadside signs, and so on. *Highway Research Board, Division of Engineering and Industrial Research, National Research Council, Washington, D. C.—50 cents.*

UTILO FILTERS AND COMBINATION LENS SHADES is a 14-page booklet devoted to a description of American-made optical glass color filters, supplementary lenses and combination lens shades. In addition, the booklet provides a comprehensive guide to the use of filters and supplementary close-up lenses under various conditions. Filter factors are given for Eastman, Agfa, and Gevaert films. Fully illustrated in color and black and white. *Photo Utilities, Inc., 10 West 33rd St., New York, New York. —10 cents.*

RAILWAY LITERATURE FOR YOUNG PEOPLE is a bibliography of books and periodicals that is designed to answer many inquiries which are received by American railroads regarding various phases of operation. *Association of American Railroads, Transportation Building, Washington, D. C. —Gratis.*

THE GLUED LAMINATED WOODEN ARCH is a 124-page illustrated booklet that deals specifically with this particular type of construction, citing advantages and disadvantages and showing many of the functional applications. Technical Bulletin No. 691, U. S. Department of Agriculture. *For sale by the Superintendent of Documents, Washington, D. C.—20 cents (coin).*

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

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WHEN OIL-WELL drills strike really hard going in rock or tightly packed shale, rock bits, such as those shown on our front cover, get the assignment (see also page 134). These bits consist of rollers which rotate on bearings as the drill pipe spins, the teeth chipping away the rock as they revolve.

SEPTEMBER • 1940

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50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of September, 1890)

EIGHT-HOUR DAY—"The House of Representatives has recently passed a bill ordaining that eight hours shall be considered a day's work for all laborers, workmen, and mechanics, now or hereafter to be employed by the government."

MONEY—"Congress ought to issue a sufficient amount of fractional paper currency to facilitate exchange through the medium of the United States mail. The people found it useful, and it never ought to have been abolished."

SINKING WOOD—"There are 413 species of trees to be found within the limits of the United States and Territories, 16 of which, when perfectly seasoned, will sink in water. . . All the species heavier than water belong to tropical Florida or in the arid West or Southwest."

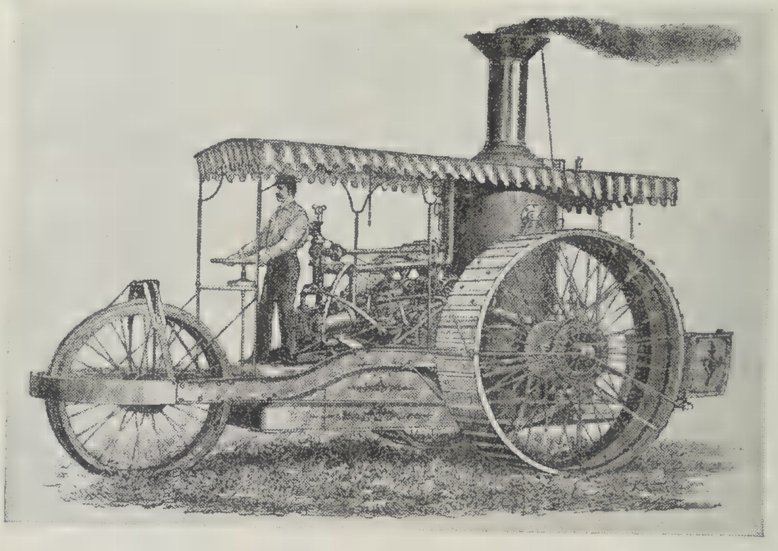
MACHINES AND LABOR—"The successful introduction of typesetting machines into a number of newspaper offices in the United States has greatly stimulated their competitors, and early in the autumn the New York *Sun, Times, World,* and other papers will commence their use. It is also said that the *Herald* will employ them. . . A member of New York Typographical Union No. 6 says: 'Of course, some members of the Union are a little skeptical as to the benefit these machines will be to the followers of the craft, but the whole history of labor-saving machinery teaches us that nothing has yet been invented that has lessened the need of good workmen.'"

COMPOSITIONS—"A new mode of treating hemp, jute, and other fibers for making materials for the manufacture of tiles, slabs, cisterns, boats, and other articles or structures has been described in a recent patent specification."

WATER POWER—"Cataract Construction Company has secured a large area of land (several square miles) on the Niagara River, beginning a mile and a half above the falls, and all rights of way for carrying a tunnel under Niagara Village to a point below the falls. The general plan is to construct a tunnel about 27 feet in diameter from a point below the falls to the upper limit of the secured property. This tunnel will have lateral branches at a depth of about 100 feet from the surface, into which will be sunk numerous vertical shafts at the points where power will be required. . . A system of surface canals will bring the water of the river to the heads of these shafts, and its action on turbines at the lower ends of the shafts will develop about 150,000 horse power. The amount of water diverted for this purpose will be a small fraction of one per cent of that going over the falls."

BROKEN NECK—"Physicians connected with the Presbyterian Hospital are highly elated over the fact of their having successfully mended a broken neck. The patient, aged fourteen years, fell from an elevator, landing on his head and dislocating his neck. When brought to the hospital the case was considered hopeless, but by experiments with extending weights attached to the patient's head and feet the neck was eventually set and kept in place by means of a plaster of Paris jacket. The displaced bones are now properly set and the patient has full power of the neck."

STEAM TRACTOR—"Among the latest machines designed for use on large farms is the new field locomotive of Jacob Price, of Racine, Wisconsin, illustrated herewith. It is said that this machine pulled, near San Leandro, an outfit of twelve 11-inch plows in a dry, adobe soil, traveling at the rate of over four miles per hour in doing so, and maintaining the steam pressure at 130 pounds, without difficulty. It will pull as much as 40 or 50 horses, besides propelling itself. Its weight is only 8½ tons. . . The carrying wheels are about 8 feet high and 26 inches wide. The steering wheel is 5 feet high and 14 inches wide. . . It is adapted for plowing, running combined harvesters,



freighting with wagons, hauling saw logs, or pulling of almost any kind, and is suitable for any stationary work, such as running thrashing machines, sawmills, etc."

SPEED AFLOAT—"The torpedo boat *Adler,* constructed in Germany for the Russian Black Sea fleet, is described by the Russian papers as the fastest war vessel afloat, having attained during its trial trip a speed of 26.55 knots. . . The boat is 150 feet long and 17 feet broad, with a displacement of 150 tons. . . Three gunboats, one of which—the *Narghen*—is finished, are being constructed in German shipyards for the Baltic fleet, and these will be almost as fast steamers as the *Adler.*"

MUSIC FROM AFAR—"An interesting and really notable musical and vocal entertainment was given recently from New York to a very large audience assembled at the Grand Union Hotel, Saratoga, by means of a 'long distance' telephone circuit running a distance of 180 miles from 18 Cortlandt Street, New York, to Saratoga. . . From Cortlandt Street a circuit had been run to the Madison Square Garden, and the concert being given by the Strauss orchestra was taken in alternation with the other numbers of the programme. The orchestral music was listened to at Saratoga by means of sets of hand telephones, and every note was heard distinctly, even to the applause of the audience gathered at Madison Square. . . Some of the songs and solos and the recitation were heard all over the room at Saratoga by means of a single loud-speaking receiver provided with a large funnel-shaped resonator to magnify the sound."

Personalities in Science

DAVID BURPEE

A TRADITION has grown up in the life of David Burpee, internationally known plant hybridist and seedsman—a tradition centering around a 33-year search for a yellow sweet pea. He hasn't found or produced it yet but, oddly enough, has given to the world other improved yellow flowers.

Mr. Burpee was born in Philadelphia, Pennsylvania, April 5, 1893. He was educated at Blight School, Philadelphia; Doylestown High School; Culver (Indiana) Military Academy; and the Agricultural College, Cornell University. His father gave him the choice of Cambridge (England) or Cornell, and young David, who had traveled many times to Europe, paid a special visit to Cambridge before selecting Cornell.

David Burpee started on his career to achieve new flowers for American gardens as a youth of 14 and has contributed much to floriculture. He has been very successful in producing new strains of petunias, zinnias, marigolds, and calendulas, but has not yet achieved that which started his deep interest in horticulture: the production of a pure yellow sweet pea for which his father, founder of the W. Atlee Burpee Company, offered him a reward of $1000. To a young schoolboy, this sum looked like stupendous wealth.

At the Burpee seed farm at Lompoc, near Santa Barbara, California, young David and his brother, whom he had inveigled into joining the search, trudged up and down, row after row of the 400 acres of sweet peas hoping to find that Nature might have done the trick and turned up a yellow break. No luck there, so he avidly read book after book on genetics and plant breeding, obtained seeds of over 150 species of the sweet pea family from all corners of the globe, grew them at his Fordhook Farm near Doylestown, Pennsylvania, and the following summer pollinated hundreds by hand — a back-breaking task. Today, 33 years later, he is still trying to produce a yellow sweet pea.

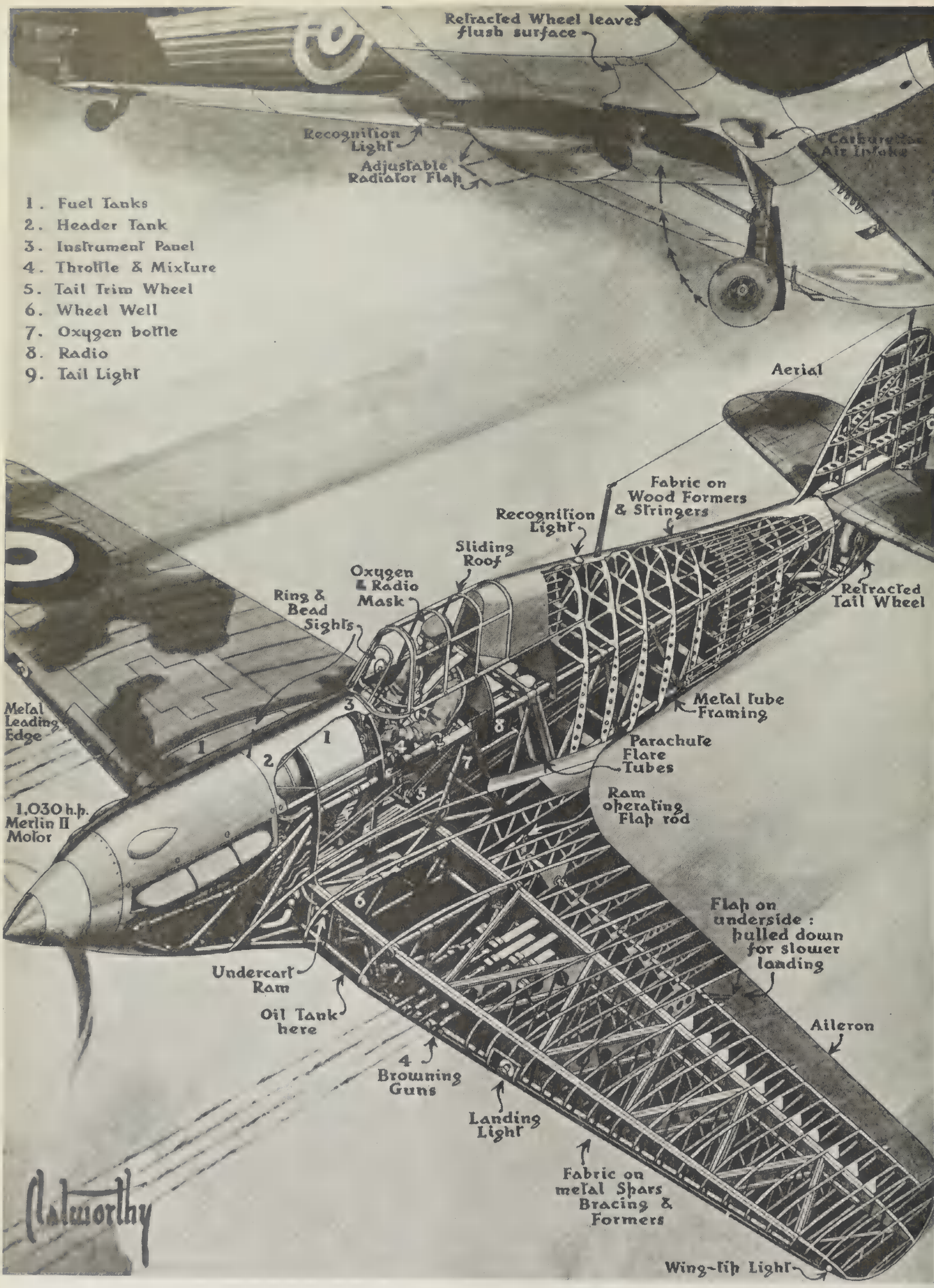
At 21, he was assistant to his father in their seed business and a year later became General Manager. Three years after first joining the company, he became President when it was incorporated in 1917. Among his other interests, he is Director of several banks and trust companies; has served as vice president and president of the American Seed Trade Association; is Vice President, National Sweet Pea Society of Great Britain; Honorary Life President of the Canadian Society of Philadelphia; director or trustee of several hospitals, horticultural societies, and the like, and is a member of prominent clubs.

"Flowers have fashions just like clothes," Mr. Burpee says. "In the old days, gay blossoms forming a hodge-podge of color were the garden vogue but, today, we want color in mass whether it be soft pastel shades or vivid hues, and it is the production of these 'fashion flowers' that keeps the hybridists and plant breeders busy."

David Burpee was the first to produce a big marigold with truly odorless foliage, the first double red hybrid marigold, and the first double nasturtiums in all colors.

The first super-double nasturtium, having 75 petals, was another of Mr. Burpee's floral successes. He purchased seed of the original Golden Gleam, grew them at the company's Floradale Farm, Lompoc, and crossed them with 40,000 other nasturtiums in the hope of producing a new flower. Finally he was successful and the first seeds and cuttings—so heavy was the demand that the supply of seeds alone was inadequate—sold for 10¢ each which was an unheard of price for nasturtiums.

What a vast story of adventure, hard work, and disappointment lies behind each of Mr. Burpee's floral achievements! His aim has always been to work with and produce fool-proof seeds that would grow in any garden rather than to experiment with rarer flowers with which the average gardener would be apt to have great difficulty.



A HAIL OF LEAD FIRE OVER ENGLAND

THIS British "Hurricane" fighter is a formidable opponent. Eight Browning guns, mounted in the wings, are aimed by "aiming" the plane, and fire a total of 2400 rounds in 10 seconds. Speed of the plane is 340 miles per hour (recently increased 10 percent); ceiling is seven miles: and cruising range 600 miles.

COAL TAR BEGAN IT

Vast Increase in U. S. Organic Chemicals Industry

CHARLES M. HACKETT

In 1919, the Committee on Finance of the United States Senate weighed a serious question: should the government "promote the establishment of the manufacture of coal tar products in the United States." Before the group appeared a distinguished witness, Dr. Marston Taylor Bogert, senior professor of the Department of Chemistry at Columbia University.

Dr. Bogert painted no rosy picture. He described organic chemical research in this country at that time as being "on a fragmentary basis." Further, he noted that such a development would have far-reaching consequences in bolstering the national defense.

"Gentlemen," he testified, "I have no hestitation in saying that a well-developed synthetic dyestuffs industry is absolutely necessary for the security of our country."

In two decades the significance of that testimony has re-shaped the American industrial pattern.

Dr. Bogert did not mean that America had no chemical industry. As early as 1865, the value of chemicals produced in this country was about $60,000,000. In 1910, the United States produced three times as much sulfuric acid as Germany, and twice the alkalies produced by England. The value of chemical products in 1914 was quoted by the U. S. Census of Manufacturers as in excess of two billion dollars. Satisfactory progress had been achieved in acids for the steel and fertilizer industries, and other so-called "heavy chemicals."

The noted professor's concern was caused by the fact that the World War, then just concluded, had disclosed a woeful lack of both the knowledge and manufacturing facilities required to produce many essential materials that could only be made by greater knowledge and application of organic chemistry.

The situation described by Professor Bogert led to an intensive program of chemical research which, in less than a quarter of a century, has produced one of the

SCIENCE IN INDUSTRY

greatest organic chemical industries in the world, and which still seeks new knowledge and new ways of applying the products of this industry to the everyday lives of millions of people in this and other countries. Evidence of this continued search may be found in the report that the American chemical industry spent an estimated $20,000,000 on research in 1937, alone. Only the steel and petroleum industries are said to provide for comparable expenditures.

Organic chemistry has synthesized the dyes, textile fibers, pharmaceuticals, flavors, perfumes, and scores of similar products which have caused some to designate the present as the Chemical Age.

This industry is a substantially 100 percent American development. American initiative has directed its course, the methods employed in building it up were American methods, and it has been financed by American capital. This does not mean that we have not profited from foreign developments and foreign experience. We have, and gratefully acknowledge it.

The organic chemical industry now ranks close to the top of American enterprise. It has promoted the growth of new industries and stimulated many older ones. It has brought the good things of life to more people, and it has bulwarked national self-sufficiency.

No one alert to contemporary developments need be told of chemistry's importance. But the *rate* of growth is impressive to the most casual observer.

In 1914, we made only about 10 percent of the dyes we used, and even that small amount was based on imported intermediates. In 1938 we produced some 96 percent of the dyes consumed in this country, and had an export balance of more than five million pounds.

Since 1919, when organic chemicals manufacture was in its infancy here, countless new products have been developed. Of those known in 1919, U. S. production has increased steadily. The average *annual* increase in flavors and perfumes between 1919 and 1937 was 29 percent; in photographic chemicals, 22 percent. Total coal tar finished products showed an average annual rise of 18 percent. In the 17-year period 1921-1937, production of non-coal tar organics—including synthetic methanol and other alcohols, acetic acids, acetone and various amines—showed an average *annual* growth of 685 percent!

Americans past the age of 30 may grasp some idea of the significance of the above figures if they compare the increases with that of the automobile industry, whose products they have seen filling the streets with more and more cars year after year, and for which they have watched broad ribbons of highways built from coast to coast. Yet the average annual increase in automobile production between 1919 and 1937 was but 9.6 percent, as compared with the spectacular rise in various organic chemicals. That the rise has been less noticed may be accounted for by the fact

that the products of chemistry, for the most part, remain hidden and do not add to traffic problems.

With this accelerated production have come price declines as phenomenal as manufacturing increases. The average price of coal tar products dropped between 1919 and 1937 from $1.02 a pound to 41 cents; coal tar dyes from $1.07 to 55 cents. Flavors and perfume chemicals fell from $2.27 to $1.02. Phthalic anhydride, used in the manufacture of alkyd resin finishes and certain dyes, is available today at 15 cents a pound, although it was around $6.00 a pound in 1917. Production of this important industrial chemical during 1939 is estimated at 60,000,000 pounds.

Plant where several well-known organic chemical products are made — du Pont plant at Deepwater, New Jersey. Note many buildings

Certain inorganic chemicals used in making organic products have likewise enjoyed important price reductions. During the 1919-1937 period, sulfuric acid dropped in price about 31 percent; caustic soda nearly 45 percent.

These advances in production and reduction in prices have affected the lives of virtually every American, and have created a high degree of dependence upon organic chemicals. They pervade nearly every aspect of contemporary life, and fundamentally affect our national economy.

This development stretches into the nerve centers of the country's economic system. It has provided jobs directly for thousands of workers—how many thousands it is difficult to compute. Countless additional employment avenues have been opened up by providing raw materials for many new industries. Dyestuffs, pharmaceuticals, and plastics provide conspicuous examples. Some products in these classifications have been made for many years, but in a larger sense they represent new industrial entities.

Plastics of the nitrocellulose type have been known and employed since 1869 (Celluloid), but the modern plastics industry with its versatile performances could not operate without a plentiful supply of organic chemicals. Acetic acid, synthetic camphor, and phenol could be cited. Formaldehyde and urea, a gregarious pair useful either in harness or singly, are found in a variety of well-known plastics.

The industrial importance of camphor may be emphasized by its use in motion picture film, which demands more than a half-million pounds a year. Camphor was controlled by a Japanese monopoly only a few years ago, and under Japanese domination the price of refined natural camphor went to $3.55 a pound in 1920.

TODAY refined synthetic camphor is selling for about 60 cents a pound, while the technical grade used in plastics and photographic film sells for around 35 cents. American chemists have learned to make camphor from southern turpentine. It is of high quality, chemically identical with the product long sacred to the fragrant forests of Formosa. The Du Pont Company is supplying more than half the total domestic consumption of this important material.

Imported urea cost about 57 cents a pound, corresponding to more than $1100 a ton, in 1920. Now urea of equal or better quality derived from carbon dioxide and ammonia sells at the plant for $85 a ton—and a domestic source furnishes practically every pound of urea consumed in this country.

New materials for making wholly new plastics have been found. The sparkling "Lucite" methyl methacrylate plastic with its extraordinary toughness, beauty, and optical properties, is a notable example. In fact, the entire modern plastics industry is the precocious child of organic chemistry.

Still other organic chemicals, synthesized to meet definite specifications, have likewise aided development of new industries. The "Freon" fluorinated hydrocarbons afford an excellent illustration of such made-to-order products. Not only is "Freon" an excellent refrigerant, but it is non-poisonous, non-explosive, and non-flammable. This combination of properties lent great impetus to air-conditioning. This new type of refrigerant is widely used today in the air-conditioning units of theaters, hotels, office buildings, and railroad trains.

Of outstanding importance in the manufacture of rubber goods are the new and improved organic accelerators, anti-oxidants, sun-checking inhibitors, and agents which nullify the destructive influence of slight traces of copper. The fact that today's automobile tires give some 25,000 miles of service in comparison with 5000 miles only a few years ago is due in no small degree to the use of such organic rubber chemicals.

Synthetic rubber-like materials developed within the past few years have been accorded a hearty welcome by fabricators of rubber goods. Although different in composition from natural rubber, the physical properties of certain of these synthetic materials are similar to those of rubber. At least one of these new materials—neoprene—has qualities not found in the natural product, including resistance to oils, greases, chemicals, sunlight, and oxygen. It fills hundreds of needs that natural rubber cannot fill, and this chemical rubber is based on abundant domestic raw materials — coal, limestone, and salt.

Discussion of the role of organic products would be incomplete without reference to rayon. This country produced some 288,000,000 pounds of rayon in 1938; the more recently developed products such as "Vinyon" and the polyamides known as nylon open promising horizons.

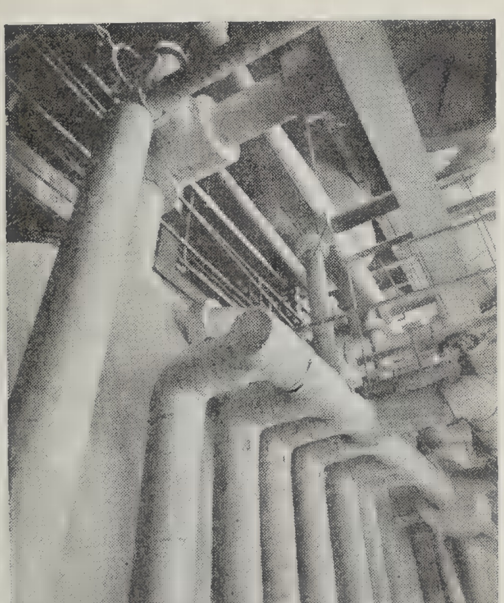
The work that organic chemicals have performed in the automobile

industry has become classically familiar, although it often is not thought of in terms of chemistry. Nitrocellulose lacquers, developed about 1921, represent one of the greatest contributions. By cutting down finishing time with orthodox enamels, durability had been sacrificed, but the nitrocellulose lacquers are both quick-drying and durable.

The recent development of polyvinyl acetal plastics has a direct bearing on the automobile industry. For many years safety glass for windows and windshields was made with an interliner of nitrocellulose or cellulose acetate plastic, but last year it was found that an interliner of a certain type of polyvinyl acetal plastic has definite advantages over the cellulose plastics, This new type of plastic is extremely tough and elastic not only at ordinary temperatures, but at low temperatures as well. It is for this reason that the polyvinyl acetals—products of the organic chemical industry—make possible the safest safety glass ever made.

Synthetic organic chemicals find numerous important applications in the manufacture and use of petroleum products. Cracking processes have had the effect of doubling national oil reserves as far as gasoline is concerned. On the other hand, cracked gasoline in storage has a tendency to develop gums which lead to clogging of motor and fuel lines. Certain organic chemicals, however, have substantially eliminated this tendency.

In the manufacture of perfumes, materials known as "fixatives" are used. One of their functions is to make the odor more lasting. Until a few years ago, all fixatives were of animal origin, such as the musk from a species of deer in Tibet. The characteristic ingredient of natural musk, if it could be had in a perfectly pure state, would probably be worth its weight in gold several times over. Within recent years, however, synthetic musks have been developed, and at least one of these new organic compounds is substantially identical with the characteristic ingredient of natural musk. These sell at a fraction of the cost of the natural product.



Stills used in making synthetic camphor from CO_2 and ammonia

To the enrichment of American harvests, the organic chemical industry has made many notable contributions. Urea, a synthetic nitrogenous chemical, not only finds application in plastics, but also as a fertilizer ingredient. Organic mercurials are being used successfully for the control of various plant diseases caused by fungi, and the long-chain alkyl rhodanates are combating the ravages of sucking insects on certain agricultural crops.

Nowhere have organic chemicals played so vital a role as in the prevention and cure of disease.

Not long ago a little girl was stricken with a much-dreaded streptococcus infection. Her terrified parents were astonished to see their physician view the danger calmly.

"Now," he said, "we have a new weapon for such infections—sulfanilamide."

The little girl got well.

Although introduced into the materia medica only a few years ago, this coal-tar derivative has already saved the lives of thousands suffering from "blood poisoning," peritonitis, streptococcic sore throat, puerperal or childbirth fever, meningitis, and other dangerous maladies resulting from streptococcic infection.

Fundamental research in such sciences as chemistry, physics,

Packing synthetic camphor as it leaves the flaking machine

biology, and pharmacology are believed to hold the key to the great medical developments of tomorrow. Chemotherapy, itself fully as important as the first work of Pasteur's laboratory, is nurtured by the organic chemical industry. A long list of new organic compounds awaits the attention of the research workers in pharmacology and experimental medicine. Pharmacological development will continue to be supported to an increasing degree because of the chemical manufacturing industry's growth.

The research chemist has established the constitution of certain of the hormones. These little-understood secretions of the ductless glands in some degree affect the functioning of the mind as well as regulate the chemical reaction of the body. Some of these "chemical messengers" have now been synthesized in the laboratory. Developments in this field offer promise of cure for certain mental ills which have baffled medical science for ages.

• • •

Breath of Industry

Oxygen Torches Cut, Condition, and Prepare Steel; Drill Stone and Concrete

HAROLD LAWRENCE

THE air we breathe is being used in some mighty strange places. More particularly, the oxygen of the air supports many industries just as it supports us. Steel is being conditioned with the aid of oxygen. Steel plate edges are prepared for welding by this same gas. Precise shapes are being cut with oxygen, replacing a multiplicity of machine tools. Steel structures are prepared for painting with the oxy-acetylene de-scaling tool. And both concrete

Oxygen flame rapidly cleans steel surfaces for painting

and rock are being drilled in this same manner.

Most of the oxygen being used in these new industrial operations is separated from the air. Yet in some cases where there is an outlet for hydrogen, too, as in the packing industry, oxygen is obtained from water. Whatever the source, the utmost in purity is demanded. The oxygen used for cutting must be every bit as pure as that used in hospitals; 99.5 percent or more pure. If it takes 100 cubic feet of 99.5 percent pure oxygen to do a specific cutting job, it will take 160 cubic feet of 97.5 percent pure oxygen to do the same job. And that's the very reason that causes engineers, cost accountants, and production men to watch the purity of the oxygen with an eagle eye.

One of the most spectacular applications of oxygen has taken place in the steel industry. Here, conditioning of blooms and billets has always been a costly and slow operation. When steel is poured from the ladle into an ingot mold, some splashing occurs. Such splashed steel sticks to the mold walls and leaves a scab on the rolled product. Furthermore, cracks and laps and laminations as well as other surface defects may show up during the rolling of the steel. So just before the final rolling operation, inspectors go over every inch of the steel surface looking for these defects; finding them; and marking them for removal. There on the billet dock—where semi-finished steel is inspected—the skin of the steel is given a beauty treatment.

No doubt few of you have ever stood on the billet dock of a steel mill listening to the roar of hundreds of chipping guns. The roar ebbs and flows and grows until you feel sure that your ear drums will burst. If you have never heard this awe-inspiring sound, you never will. The almost soundless hiss of a small stream of oxygen has silenced the roar forever. Chipping guns have been scrapped. Men's nerves aren't jarred by bucking air-hammers all day long. Steel conditioning costs are down. Production speeds are up. And, despite the tremendous quantities of oxygen being removed from it every day, the air still remains one-fifth oxygen.

Perhaps one might think that the introduction of flame scarfing to replace slow chipping operations on the billet dock satisfied the steel men. No; the increased speed and lower costs made these men eager for more improvements. Out of the oxygen research laboratories they came. No longer did the steel blooms and billets have to cool in endless rows and piles before getting their skin treated. Now the glowing steel thunders from the hot shears to a peculiar looking device whose many-fingered arms nestle into place. A control is operated. Hundreds of jets of oxygen open, bathing the unhealthy skin from the steel.

THE octopus device draws back its tentacles. The steel rolls and bounces down the roll table to the reheating furnaces where it will be reheated for the final rolling operations. Note that the steel can be charged into the reheating furnaces hot instead of cold; the heat locked up in the steel isn't wasted. Thus fuel consumption per ton of steel produced was reduced a little more. The process of removal of slight surface imperfections, known as steel conditioning, was modernized. Production no longer remained at the mercy of the snail-like conditioning operation. Pure oxygen changed all that.

But the steel industry is not the only industry to benefit from research into the industrial application of oxygen. When boiler and pressure vessel manufacturers progressed from riveted to welded construction, old-time boiler-makers hung up their riveting guns with a sign of relief. The ungodly clatter was over. A good riddance, too. But along came construction codes such as that sponsored by the American Society for Mechanical Engineers demanding the removal of the unwelded zones between the two sides of a weld, these zones being necessary to hold the molten metal temporarily.

Down came the air-hammers. This time they would be used to drive diamond-point chisels. Back came the racket and the roar—the same unnerving noise that had made such a bedlam of the steel billet dock. But not for long.

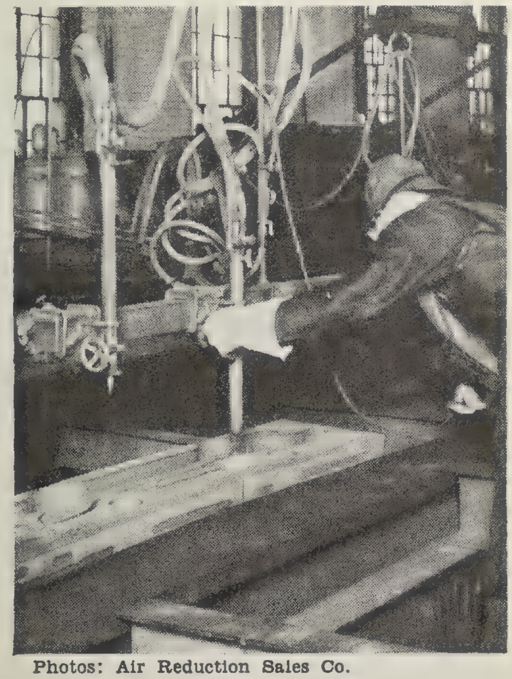
Oxygen men were not ready to ring down the curtain on another possible application of their equipment. So flame-gouging was born. The same oxy-acetylene preheat flames backed up by a low-pressure stream of oxygen, delivered through a special nozzle, would do the work of the diamond-point chisels. Not only would the oxygen *do* the work, but best of all, it would do it both faster and cheaper. So, again, away with clang and clatter! Quiet oxygen would soothe frayed nerves! And lo and behold, overall plant efficiency increased almost 15 percent in one plant—attributable to noise elimination alone.

As the pressure vessel industry grew, demands were made for heavier and heavier plate. Economical welding procedure demanded U-shaped welding grooves. Until quite recently the only tool for making these welding grooves was a plate planer. About the only objection some shops had to the installation of a plate planer was the cost. For a good plate planer costs more than eight times as much as the most expensive oxygen bevelling equipment. Back to their researches went the oxygen men. And out of their work came efficient oxy-acetylene plate edge preparation at a cost within the

Steel is cut cleanly, rapidly with the oxy-acetylene torch

reach of all. When the oxy-acetylene torch completes its work, the plate edges may be placed together to form a perfect groove.

Increasing temperatures and pressures placed great responsibilities upon the shoulders of pressure-vessel manufacturers. To prove the quality of the welds they made, they pressed into service the X-ray. As was anticipated, the X-ray pictures disclosed infrequent defects



Photos: Air Reduction Sales Co.
Using a template guide, an oxygen torch cuts machine parts

in the welds. Such defects were chipped out—a slow and laborious process. Luckily, the same tool that was used for gouging the unwelded portion of a seam and for plate edge preparation, might be used for removing these defects.

For some time, the use of the oxy-acetylene torch for severing steel has been common knowledge. Even the adaptation of this tool to rough-shape cutting has been known by many. But the development of precision tips, that eliminated all other finishing operations involving the use of machine tools, came quite recently. Here the perfection of precision nozzles led to unbelievably close tolerances. How close? Well, from three-thousandths of an inch in one-inch plate to slightly more than three-hundredths of an inch in six-inch plate.

Meanwhile, the men in oxygen research saw another opening for their tools. For many years, the painting industry had been preaching the importance of the proper preparation of steel for painting. Sand-blasting, pickling and chipping had all been used with success. Each process had its advantages and disadvantages, of which the latter were mostly concerned with the slowness of the process. A special tip emerged from the development division to use oxygen in combination with acetylene for rapid and certain flame descaling. By quickly raising the scale on the surface of the steel to a high temperature, the descaling torch turned the trick. Differential expansion of the oxide skin and the steel below caused the scale to fly off. The scale-free dry steel that remained was ideal for painting.

Now we come to one of the most recent milestones on the oxygen road of progress: hole-drilling in both stone and concrete. Rock is quarried by drilling blasting holes in which dynamite is used to blast huge blocks of material out of the formation in which they are found. Heretofore this drilling has been accomplished by cumbersome and expensive machinery. Once more the operators might have struggled along with both heaviness and cumbersomeness if the machines hadn't been so slow. Then along came a special oxy-acetylene torch and tip that drilled the holes in rock with speed. Although speed ruled, I must admit that the lighter equipment and greater economy which were thrown in for good measure helped to swing the balance in favor of the flame process.

Frequently holes must be drilled in concrete. This stubborn and unyielding man-made rock is conquered slowly with a star drill and pneumatic gun. Powdery concrete emerges from the hole so slowly as to tax the most angelic patience. No rapid drilling of concrete was ever possible; that is, not until the advent of oxy-acetylene drilling.

Both stone and concrete contain water. In flame drilling, the concentrated heat of the oxy-acetylene flame turns this water to steam. The steam, trapped as it is on all sides, explodes. And the hole is drilled not only with speed but also with economy. I'm not going to mention speed or economy again. By this time you must know that these two words are synonymous with oxygen processes.

Ever notice a runner at the end of a long race? He is fighting for oxygen to replace that which he has burned up while running. Not so industry. Industry is breathing easier in its oxygen tent. This ubiquitous gas has eased the struggles of industry in many places.

Nothing has been said here about welding, brazing, or soldering with the oxy-acetylene torch. Nor has anything been said about flame hardening or flame softening. But why go on? Even as I write, the oxygen men are putting the finishing touches to developments that will make the story of oxygen even more unbelievable.

• • •

HOT-SPRAY

Lacquer Finishes Applied Faster And at Less Cost

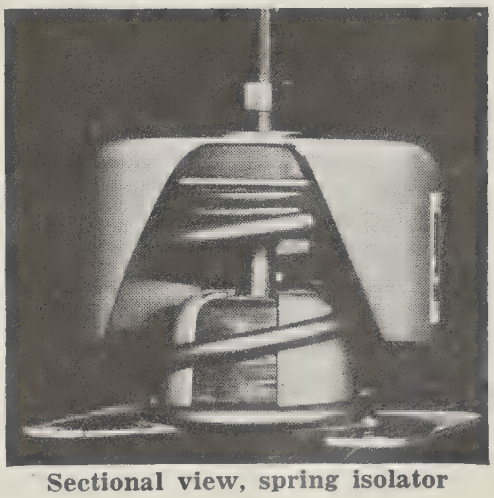
In virtually every system of surface finishing, the ultimate object is to obtain the greatest degree of permanent protection with the least amount of labor and material. The cost of the finishing process is proportionate to the amount of solids on the surface when the finishing operation is completed.

In strict keeping with these basic principles, the new P&S hot-spray lacquer system produces, in a two-coat finish, the solids ordinarily obtainable in a three-coat cold lacquer finish. The heat employed in this machine gives spraying consistency without the use of thinners or solvents. Consequently, with this equipment, the manufacturer claims economies in amount and cost of material used, application time, drying time, and labor and handling costs.

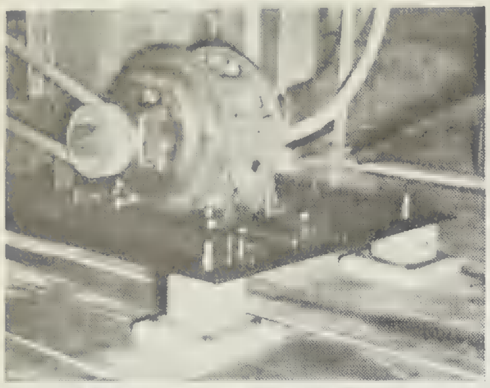
SPRING ISOLATOR

Machine Mounting Damps Noise and Vibration

A new, easily installed vibration isolator, designed as an economical means to control machine vibration and reduce the resulting noise, was recently announced by Johns-Manville. This device, known as the J-M Controlled Spring Isolator, was developed for use on the bases of motors, generators, pumps, ventilating fans, and similar equip-



Sectional view, spring isolator



Motor on spring isolators

ment where vibration and excessive motion create noise and tend to wear out machine parts and damage connections as well as to crack the supporting walls and floors.

The working parts of the unit consist of a coil spring and a rubber load pad, which support the equipment and isolate vibration—and an adjustable rubber snubber inside the base, which controls excessive motion

The isolator is built to take care of horizontal and torsional as well as vertical vibration. It is efficient for the low frequency vibrations resulting from slow speeds and from many operations involving reciprocal motion. The load pad is designed to overcome any high frequency vibrations.

The device is made in two sizes: Light duty, for loads from 50 to 190 pounds per isolator; and heavy duty, for loads from 250 to 720 pounds per isolator. Heavy machines may be isolated by clusters of the units. The loaded overall dimensions of the unit are six by six inches by approximately 3¾ inches high. It is enclosed in a metal jacket which protects the rubber parts from oil and light.

FACTORY RUBBER

New Synthetic Useful For Tires

On page 125 of this issue, Philip H. Smith touches upon the so-called synthetic rubbers, indicating that we are not yet in a position to replace natural rubber with the synthetic variety. The newest of these synthetics, which is equal or superior to natural rubber in many of its properties and can be processed and vulcanized like the natural product—in making tires, for example—is claimed by the developers to be capable of radically reducing our dependence upon natural rubber which must be imported. Of course, this factory product is more expensive than latex rubber and only in a great national emergency would sufficient plants be constructed to make it in large quantities.

The basic raw material for this new factory-made rubber, which has been named Ameripol by the B. F. Goodrich Company, is American petroleum. Dr. Waldo L. Semon, its discoverer, explains that the petroleum is broken down by the cracking process to a mixture of simple molecules. From this mixture can be separated a gas which, under pressure, liquefies to give butadiene. This is mixed with other ingredients prepared from natural gas and air and then made into a milky emulsion, using soap produced from American agricultural sources. Upon heating and agitation, these ingredients react to form an emulsion of synthetic rubber, which is similar to the latex obtained from rubber-producing trees. From here on, the process of obtaining a sheeted rubber is quite like that used for natural rubber. The latex is coagulated with acid, producing a curd. This is then sheeted and dried to give the Goodrich synthetic.

PROGRESS

Hand of Research, a Midas Touch on Machines

For the benefit of all those who may be critical of scientific research in any respect, we present an accompanying photograph showing four versions of the lowly washing machine. No women accustomed to the 1940 model would ever be content to use again the 1919 model. Yet despite the significant story told in this group picture of four machines, there are still some people who claim that new models are built solely for catch-penny purposes—to exploit the consumer.

Scientific research made possible the vast improvements shown in this group picture, not the least part of that improvement being the reduction in price by about one half for a modern machine that does better work than its earlier prototype.

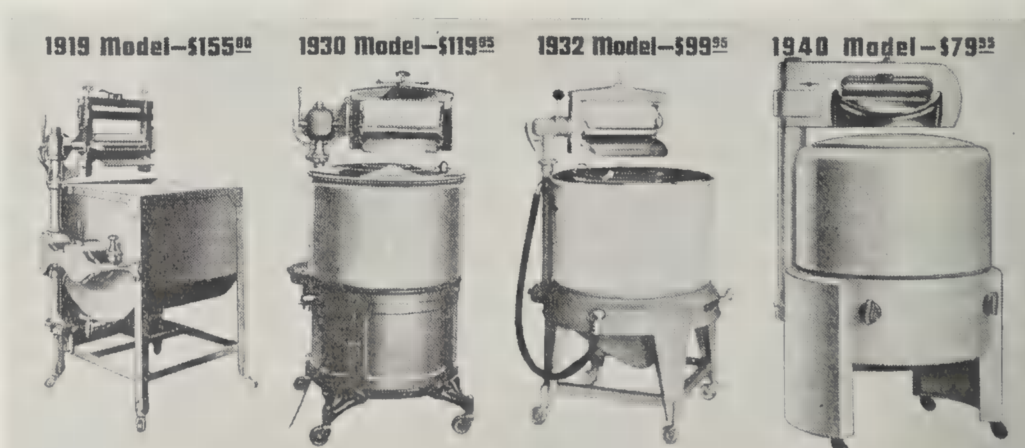
MOLDED AIRPLANES

New Pressure Tank Ordered For Production

A super-size molding tank for so-called plastic airplanes and parts has been ordered for the Duramold Aircraft Corporation, a subsidiary of Fairchild Engine and Airplane Corporation. The tank, 10 feet in diameter and 28 feet long, will be installed in the Grand Rapids plant of the Haskelite Manufacturing Corporation, co-owners of the Duramold process. The quick-acting door of the tank alone weighs 13 tons.

The so-called plastic airplanes are not, as is generally thought, made by pouring a plastic into a hollow mold, but rather are made of wood fibers in the form of thin veneers bonded together with plastics under heat and tremendous pressure. [See Scientific American, July 1939.—*Editor.*] By utilizing and preserving the tremendous natural strength of properly arranged wood fibers, a new material is obtained, which is not only stronger and lighter than pure plastics, but one that compares favorably with riveted aluminum alloys. Duramold engineers emphasize the fact that all the raw materials used in plastic airplanes are available in large quantities in this country.

Duramold Aircraft Corporation was the pioneer in developing synthetic materials and processes for molded airplanes and flew a plane,



Courtesy Lincoln Electric Co.

One of many examples of industrial progress brought about by research

with a molded fuselage, over two years ago. Production molded units made by the Duramold process are now in use in the Fairchild Army training plane and on planes of one of the major airlines.

According to *Modern Plastics* magazine, four aircraft companies are now working intensively on the problem of molded airplanes, two major research institutions are investigating various phases of the subject, and the Army Air Corps and the Navy Bureau of Aeronautics are closely watching all developments as well as carrying on tests in their own laboratories.

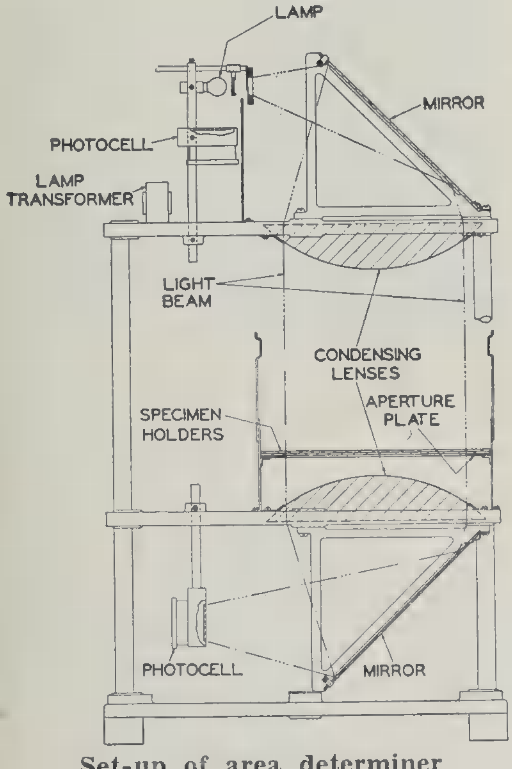
Can labeler; paste (left), label pick-up (center), label pile (right)

AREA DETERMINER

Machine Measures Areas Fast and Accurately

PLANIMETER measurements of areas are slow. While they are relatively accurate, they are not exactly so. A new area determiner developed by the American Instrument Company utilizes a photo-electric cell and accurately ground optical lenses and is, therefore, faster and more accurate than any device depending upon the human senses. It will determine the areas of maps, printed designs, stampings, punchings, engine indicator diagrams, plant leaves, and many other irregularly shaped flat objects that will fit into a 9.93-inch circle. If the object is transparent, it must be temporarily coated with a translucent or opaque material.

Inside the 42-inch high cabinet are two 12-inch condensing lenses, two diffusing screens, two mirrors, and two photo-electric cells. A galvanometer is used for determining the balance point between the two cells. To operate the machine, after plugging it into a 115-volt socket, the dial on the face of the cabinet is first set at zero by balancing the two cells. The flat object to be measured is then placed between glass plates over one of the lenses. The galvanometer deflects and is then brought back to zero by turning the dial. Finally, the dial reading is multiplied by five to obtain the area in square centimeters.



Set-up of area determiner

LESS TIN

New Tinning Process Saves Vital, Imported Metal

TIN is one of those vital raw materials which the United States must import. Although this country uses a relatively small amount—about 40,000 tons yearly—to make tin cans, there is not yet a completely satisfactory substitute for it. Therefore, if our imports from the Dutch East Indies and the Straits Settlements were cut off, an enormous canning industry would feel the pinch of the war.

Professor Colin G. Fink, of Columbia University, from whose laboratory many metallurgical and metal plating processes have come, has now developed a process which permits much thinner tin plating on the iron sheet that makes the tin can. According to recent reports, this process would save half the tin now used for this purpose. His new process involves electro-chemistry instead of dipping.

RAPID LABELER

1400 Pineapple Cans Labeled Per Minute

THE fact that up to 1400 cans are labeled per minute at the Hawaiian Pineapple Company's cannery in Honolulu is a record made possible by improvements on standard can-labeling machinery. All of the machines were originally standard Knap machines, but have been re-designed to raise the speed as much as 50 percent over that at which the labelers are usually operated.

The Hawaiian Pineapple Company, growers and packers of Dole products, evolved a new design to speed up the operation of the original labeler. The pick-up paste pan has been fitted with two sets of rollers, both machine driven. One rotates clockwise, the other counter-clockwise. One set of rollers is grooved like a pulley, while the other set is pointed and operates within the groove of the first set. The pointed rollers are on a shaft made adjustable to increase or decrease the space between the meshing rollers. This permits the application of either lesser or greater amount of pick-up

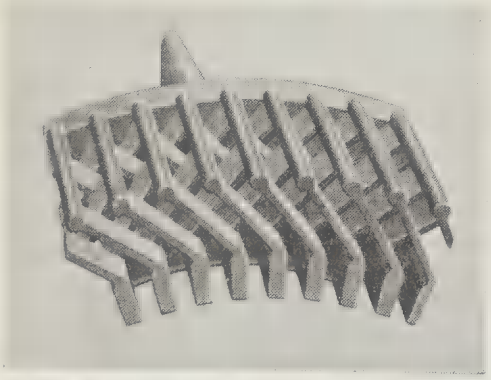
paste. The rollers are self-cleaning.

Another improvement was the introduction of a new method of feeding the cans into this fast moving machine. Trays of cans are up-ended so the cans roll by gravity onto a belt which passes them in an almost uninterrupted stream across the paste pan rollers. To supply labels to the machine, a slip drawer, which falls back to a slightly out-of-plane position, is filled with labels while the machine is running. When the labels in the machine have been used, this slip drawer is simply pushed forward into the machine after the table has been lowered to receive them. The drawer is then removed and the machine continues its operation with practically no shutdown.

ROTORS

Improvement in Induction Motor Construction

Offering the advantage of longer motor life with less maintenance, a new type rotor construction announced by General Electric makes possible the use of cast-aluminum rotors in the larger sizes of double-squirrel-cage motors for high-starting-torque, low-starting-current service. Called the "Valv-amp" rotor, it makes use of a unique shape of rotor slot and a special method of assembling rotor punchings to control the flow of starting current. As a result, without the use of a switch or other moving parts, current is permitted



Section of cast aluminum rotor

to flow in the outer squirrel-cage when the motor is started, thus producing high starting torque. Then, when the motor comes up to speed, current is allowed to flow through the entire rotor "winding," resulting in excellent running characteristics.

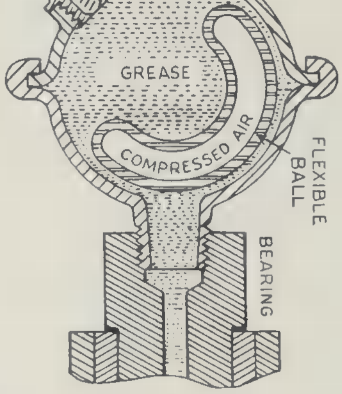
Of the two conventional methods of double-squirrel-cage-rotor construction—that is, casting the conductor bars and short-circuiting rings integral, or joining them by brazing—the former method is by far the more satisfactory because it is a simpler operation, with smaller chance for human error, and results in a more compact, uniform product. However, until the Valv-amp development, it has not been practicable to cast double-squirrel-cage rotors in the larger sizes.

The Valv-amp development, however, allows the construction of larger cast-rotor motors which inherently combine the advantages of the double-squirrel-cage motor, such as high starting torque, low-starting current, and excellent running characteristics, with advantages of the conventional cast-rotor motor—simplicity of construction, long motor life, little maintenance, and permanence of electrical characteristics.

PRESSURE LUBRICATOR

Flexible Ball of Neoprene Uses Compressed Air

A continuous, positive flow of lubricant to the wear surface of bearings while they, or the shafts,



are in motion is assured by a new pressure lubricator which is permanently attached to the lubrication passages. This device utilizes compressed air, stored in a neoprene ball, to force lubricant to each individual bearing as it is needed by that bearing.

The lubricator consists of a steel shell, designed to withstand high pressures, inside of which is a hollow, flexible neoprene ball. The shell is equipped with a standard grease fitting and a pipe-threaded outlet that screws into the standard lubrication passage.

When grease is forced into the lubricator by a pressure gun attached to the grease fitting, it collapses the neoprene ball against the pressure of the air inside of it, thus compressing this air and storing up energy. After the lubricator has been filled under high pressure, the grease flows through the bearing rapidly with a flushing action until the pressure within the lubricator drops to where it balances with the resistance of the bearing to passage of lubricant. When this static condition has been reached, further lubricant is forced to the bearing only when the bearing is in motion. The pressure balance is upset only when the bearing or the shaft is moving, causing loss of lubricant and the consequent need for replacement of the grease or oil.

The flexibility of neoprene and the ability of neoprene compounds to resist the passage of gases were two principal reasons for the selection of this material for the ball. In addition, the use of neoprene was dictated by other conditions of service—the lubricators must be effective in cold and hot weather, and they must handle all types of lubricants without appreciable deterioration of any of the parts necessary for their operation.—*The Neoprene Notebook.*

EYE ACCIDENTS

High Toll of Industrial Eye Accidents

Although safety engineers have long inveighed against the carelessness of workers who will not use the prescribed goggles when doing

dangerous work, that carelessness continues. It takes a heavy toll. The American Optical Company emphasizes the cost with the accompanying photograph, their caption saying: "It would take all the artificial eyes in this basket, and more too, to replace the 2000 eyes lost annually in eye accidents."

Such accidents cost American industry approximately $37,000,000 yearly in medical expenses and compensation.

INDUSTRIAL TRENDS

CONTINUOUS CASTING

REVOLUTIONARY changes are taking place in the hot handling of metals. During the past few years the metallurgist's century-old dream of producing billets, sheets, and strip direct from the molten metal in a single step has materialized. Billets of copper, aluminum, and magnesium alloys are being produced commercially right now and it appears that steel will soon be added. You're unlikely to hear about this because the art develops slowly, without publicity of any kind, and in some instances with absolute secrecy.

Actually, the process is one of continuous casting. In this country and in Europe there are mills casting ingots and billets of ferrous and non-ferrous metals on a 24-hour basis to prove the practical nature of the method. A New England producer is now casting over one million pounds of 7⅞-inch brass rounds weekly with a single machine, and it is possible to cast continuously billets up to 20 inches in diameter.

There are half a dozen systems in operation, commercially and experimentally. They differ as to technical details rather than as to basic principle. The molten metal flows from a holding furnace into molds which are jacketed for cooling; then, as the billet comes from the mold, it is cooled by sprays and passes on down to a cut-off saw or flame which cuts it into desired lengths. While the processes are very simple, there have been many difficulties to iron out, because so much care has to be given to temperature control, operating speeds, and molds.

Speed of production is the great achievement. According to the system, kind of casting, and its size, output may vary from 10 inches to 7 feet per minute, and these speeds are likely to be raised with further experimentation and experience.

IN STRIP FORM

To anyone familiar with rolling mill practice, the production of sheet and strip by continuous casting is more dramatic than the turning out of billets. Instead of employing multiple passes through rollers to reduce a chunk of metal to the form of sheet or strip, a single pass of the molten metal will produce thin strip (about 0.02 of an inch in diameter) of eight-inch width at the rate of 500 and more feet per minute.

There is insufficient space for relating the experiments and heartbreaks leading to ultimate success in continuous casting. It is sufficient to say that it is used to handle non-ferrous metals and more recently has demonstrated the capacity to handle high chrome, high carbon, and spring steels. There's no doubt but that it can produce tin plate, but it has yet to prove that it can outmode the great continuous rolling mill for production of automobile sheet.

Enough experimental data have been assembled to warrant the forecast of further triumphs. It is very likely, for example, that the continuous casting of tubing is not far off. This would be accomplished by inserting a stationary mandrel in the forming mold. It is also likely that the new practice will prove valuable for handling stainless and other high alloy steels because of the reduction in scrap loss.

EVERYTHING BUT THE SQUEAL

Do you recall the time honored phrase that the meat packing industry utilized every part of the hog but the squeal? Well, that's literally true, but that is no indication that the industry has reached the end of the utilization goal. The industry has shown great ingenuity in developing outlets for all the various packing by-products, but the application of science is going to find still more valuable uses and thus create vast changes for the industry and its dependents.

I could tell you that the various glands are used for pharmaceutical preparation of hormones; that the livers of calves are used in the preparation of soluble extracts to combat anemia. It might interest you to know that gall stones, found in some cattle, are shipped to the Orient where they bring as much as $150 per pound for use as amulets, but it is more to the point to tell of recent events and forecast some more.

It has just been announced that the juice of the tropical guaicum tree, used in small quantities, will prevent the oxidation of lard, so that it can be kept without refrigeration and its nutritive values preserved without chemical change. This is a discovery of great value. The lard market has shrunk under the competitive onslaught of the hydrogenated vegetable oils, known to you under various trade names, and more recently the export market has been subjected to fire. It has been vital to the live-stock raisers and to the packers to revive the market.

Lots of work is being done with gelatine. Notably, several universities are studying its fatigue-relieving effects under controlled conditions. Gelatine already has a substantial market to capsule a host of products, but it can benefit from a bigger one. Blood goes into the manufacture of adhesives and has been employed to bond cheap plywood. I venture to say that fundamental studies into the nature of animal blood will be made to give it a value which at the moment is very low. Certainly scientific progress is being made in the packing industry, and I hope to be able to announce another important discovery at an early date.

STRATEGIC MATERIALS

War has unquestionably dislocated trade and shut off the flow of commodities between this country and a large and important section of the world, but as to ultimate effect upon American industry, one man's guess is nearly as good as another's.

Viewing the kaleidoscopic events, this much can be said: Our situation in supplies of strategic materials is much better than it would have been had similar upset conditions existed a few years ago. (See Scientific American, March, 1936). The rubber problem seems pretty well licked by *ersatz* developments, although over-night production in any quantity is out of the question. We could get tin from Bolivia, but we lack the smelters necessary to refine it. It's more likely that the need for tin as a plating agent would be met by substitutes, leaving available supplies for more essential items. A possible substitute is black steel plate, coated with lacquer; another is aluminum, used as a plating.

To these chemical contributions to self-sufficiency can be added substitutes for fulminate of mercury in detonators, chinacrin and plasmochin to replace quinine, and they are talking up nylon to replace silk in powder bags and parachutes.

—*Philip H. Smith*

First Aid For Burns

Application of Tannic Acid is Procedure That Has Received World-Wide Recognition

CHARLES A. McAVOY
Burroughs Wellcome & Co. (U.S.A.) Inc.

THE standard first aid for burns in the United States Navy is an aqueous jelly containing 5 percent tannic acid and 0.5 percent phenol. Tannic-acid jelly was adopted by the Bureau of Medicine and Surgery of the Navy after ten years' successful use of tannic acid in the treatment of burns by the leading hospitals of the world.

Tannic-acid treatment of serious burns was introduced as the result of work by the late Dr. E. C. Davidson of the Ford Hospital, Detroit. Dr. Davidson was searching for a coagulant of proteins and most of his early work was with phosphotungstic acid. His attention was drawn to the fact that, for many centuries, the Chinese had used a strong decoction of tea in the treatment of burns; he replaced phosphotungstic acid with tannic acid and obtained brilliant results.

In 1925, Dr. Davidson announced the results of his work. His paper led to a world-wide adoption of the tannic-acid treatment of burns and much work and study was carried on by others to perfect the technique. Most important was the development of tannic-acid jelly which brought Dr. Davidson's discovery into the field of first aid.

First aid in serious burns, as in other injuries, must be based on the fundamental principle of first aid—"the avoidance of further damage to an injury between the time of the accident and the beginning of medical care."

It is essential, therefore, to consider just what is the most frequent and most serious "further damage" which the first-aid worker must strive to avoid in handling serious burns.

A study of current medical opinion establishes four important facts: the majority of deaths in serious burns ensue from shock and collapse; correct first-aid measures should be instituted immediately after the accident; oily or greasy preparations of whatever type must not be used as first aid; the accepted method of treating burns is the application of 5 percent tannic acid, either as a spray or aqueous jelly.

It is stated that 80 percent of deaths from burns are due to shock and collapse. The first-aid worker should be fully aware of this danger and his efforts should be to prevent or retard the development of shock during the period between the accident and medical care.

In burns, the causative factors involved in shock may briefly be stated as follows: loss of body fluids and loss of blood plasma; extreme pain; toxin absorption. Medical authorities seem in agreement that shock is the most dangerous factor involved in serious burns and that preventive measures should be taken immediately.

SHOCK begins with the injury and the first aid must be immediate in order to be effective. Every minute of the time required to transport a burned patient to a hospital adds to the danger of shock. During the period intervening between a serious burn accident and medical care, symptoms of shock may develop, retarding the efforts of the physician. Tannic-acid jelly should be applied immediately. If the injured person is conscious, some fluid should be given. The body of the injured person, including the burned area, should be kept warm.

The standard procedure in all hospitals is to treat burns with aqueous sprays. Most hospitals use sprays of tannic acid or some modification of tannic acid, while others use aqueous solutions of certain dyes. In all instances, however, the spray solution is aqueous and depends on penetration for its therapeutic value. If preparations containing oils or greases have previously been applied as first aid, the oils and greases must be removed with solvents before the aqueous spray can be used. In cases where the burn covers a large area, or the patient is in shock, the "scrubbing" of the injury becomes a serious factor.

The disaster to the airship *Hindenburg* caused many serious burns to be treated at the hospitals at Asbury Park and vicinity. Dr. O. R. Holter, of Fitkin Hospital, Asbury Park, New Jersey, wrote in the September, 1937, issue of the *Journal of the Medical Society of New Jersey* regarding his experiences with serious burn cases following the wreck. In the course of his article, Dr. Holter said: "The use of oils and ointments of various kinds, home and proprietary remedies, in the treatment of second and third degree burns is to be severely condemned."

The tannic-acid treatment of burns introduced by Davidson has revolutionized both hospital and first-aid procedure in the case of burns. Philip H. Mitchiner, M.D., M.S., F.R.C.S., in his excellent article, "Treatment of Burns and Scalds," (*British Medical Journal*, January 1, 1938) points out that, while the value of tannic acid in burns is due to its coagulating properties, it is important that the solution should have a penetrating action as well. Tannic-acid solutions of 5 percent or less penetrate deeply, so that all of the damaged cells are coagulated and the danger of a superficial coagulum (which permits toxin absorption from the deeper uncoagulated tissue) is avoided.

Treatment with tannic-acid spray, however, must always be under optimum conditions. The patient must be kept warm, the injury kept warm under a heat tent, and the solution sprayed on must be warm. Spraying must be repeated frequently for hours until the coagulum is completely formed.

Sub-optimum conditions, however prevail at the scene of an accident involving burns. Under these conditions, it would not be possible to maintain the patient and the injury warm during the treatment with tannic acid spray, even though there might be an operator trained in the technique.

With the application of tannic-acid jelly, the coagulum forms as the patient awaits medical attention and is complete in 30 to 40 minutes. No skill is required and no time has been lost; the application can be made even under unfavorable conditions and two applications should suffice. This is correct first aid.

Aqueous tannic-acid jelly has

the penetrating and coagulating properties of the spray; it seals the injury rapidly, retards loss of body fluids through the burned area, excludes air and stops irritation of nerve endings, thereby allaying pain. The danger of shock is reduced as the patient awaits medical care. Being water-soluble, the tannic-acid jelly or its coagulum can be removed by the surgeon without undue discomfort to the patient. Tannic-acid jelly not only brings the benefit of the tannic-acid treatment for burns to the field of first aid but, likewise, coördinates first aid with later medical care.

In summarizing, the most important message to the first-aid worker in handling burns is that he act immediately to minimize or prevent shock in the injured. He can best do this in the following manner:

Apply tannic-acid jelly freely over and beyond the burned area. In first aid avoid the use of sprays.

If the patient is conscious, administer some fluid to replace loss of body fluids. Keep the burned area and the patient warm. Do not use any preparation containing oils or greases. Bring the patient under medical care as soon as possible.

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STIMULATING

Modern Version of the "Medical Coil"

Relegated to many attics are "medical coils" — induction coils equipped with vibrators—that, not so many years ago, were regarded by many people as "cure-alls." The mild current supplied through handle electrodes was indeed stimulating, but certainly would not accomplish the wonders that were supposed to result.

Modern medical research, however, has found that similar currents do have value in certain cases. Thus, portable muscle stimulating equipment for physicians, a General Electric medical development, is a recent application of one of the oldest facts of electrical knowledge. The purpose is to increase circulation, to hasten, repair, and restore function as soon as possible after enforced rest or immobilization of skeletal muscles following fracture or other injury.

The apparatus, which can be adjusted by use of a vacuum-tube rectifier for either alternating- or direct-current operation, conveys to the patient through the two electrodes just enough electricity to produce a neuromuscular response at the rate of 12 contractions per minute, each simulating a natural contraction in its gradual rise to completion, with a correspondingly gradual fall to relaxation.

The name of the device, a galvanic generator, recalls Luigi

The "medical coil" up-to-date

Galvani, the famous professor of anatomy at the University of Bologna, who about 1791, while preparing frog's legs for his ill wife's dinner, noticed that electricity caused their muscles to twitch and contract.

FAIR EXCHANGE

Men and Women Swap Clothes To Bring Out Suspected Facts

Women are two degrees cooler than men by skin temperature readings but the chief reason the sexes cannot agree about what is a comfortable indoor temperature is that women's clothes are cooler. This was proved to a group of men when they donned women's filmy garments in scientific studies at the Harvard School of Public Health.

The studies were reported to the American Industrial Hygiene Association by Dr. C. P. Yaglou.

"Men dressed in women's summer clothing (weighing 1.8 pounds including shoes, compared with men's summer wear of five pounds) demanded a temperature of 80 degrees Fahrenheit, which was about the same as that preferred by women (79.5 degrees) similarly dressed," Dr. Yaglou reported.

"Reversely, when women wore men's winter clothes (8.3 pounds instead of 2.6 pounds, the average of women's winter garb) the comfortable air temperature was just as low (70.5 degrees) as that preferred by men wearing the same clothes."

If men would wear a coatless and vestless dress with the lightest of underwear in hot summer weather, rooms would not have to be cooled below 85 degrees Fahrenheit for comfort, Dr. Yaglou said. The present standard is from 76 to 80 degrees. With men garbed for a temperature of 85 degrees Fahrenheit in summer, there would not be the trouble now experienced from exposure to sharp temperature contrasts between apparently chilly air-conditioned buildings and the heat outdoors.

In winter, Dr. Yaglou said, a room temperature of about 70 degrees Fahrenheit would be comfortable for both sexes in the coldest weather, if women wore more and warmer clothes and buildings were suitably insulated.—*Science Service.*

POISON IVY

New Method of Protection Excludes the Poison

A vanishing cream that gives protection against poison ivy has been developed by Dr. Louis Schwartz, Dr. Leon H. Warren, and Frederick H. Goldman of the United States Public Health Service and the National Institute of Health, Washington, D. C. The cream is made by correctly mixing either sodium perborate or potassium periodate with vanishing cream.

Tests on nine volunteers showed that the cream protects against both poison-ivy extract, which is at least 30 times as powerful as any poison ivy leaf, and against the leaves and stems of the plant itself. Two volunteers, one most susceptible and one medium susceptible to poison ivy, after rubbing on the cream, pulled out poison ivy plants by the roots, plucked the leaves, and rubbed them over their skins. Neither volunteer was poisoned.

The cream is made by adding 10 percent sodium perborate, or 2 percent potassium periodate, to vanishing cream. The chemicals come in crystal form and should be ground to powder before mixing. The vanishing cream should be made first and the chemical added. The cream should be freshly prepared for use, to avoid deterioration.—*Science Service.*

Interstellar Gas

More and More, Astronomers are Finding Matter as Particles Between the Stars

HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

An unusually interesting discovery has just been announced—namely, that molecules of chemical compounds, as well as isolated atoms, are present in the excessively rarefied gas which is found in the vast "empty" spaces between the stars. The evidence, of course, comes from the spectra of distant stars whose light has traversed long paths through interstellar space.

It has been known for many years that the H and K lines of calcium (absorbed by the ionized atoms of the element) are present in the spectra of many very hot stars, and are very sharp—mere hair-lines across the spectrum—while the other lines are broad and fuzzy. The latter behavior is easily explained as a result of rotation of the stars, and of relatively considerable density in their atmospheres—both of which tend to widen the lines. But the sharpness of the calcium lines indicates that they originate in a gas of very low density, remote from these disturbing effects. A cumulative weight of evidence has convinced everyone that this gas is nowhere near the individual stars, but distributed generally—though probably more or less patchily — in space. The yellow D lines of sodium were next found to appear with the same characteristics in the same stars. Later the ultra-violet pair of sodium was discovered, the red line of potassium, several lines of titanium, and, in a few cases, the strongest line of neutral calcium—though very faint.

It is now evident that interstellar space is by no means empty. Indeed, there is probably a great deal more in it than our spectroscopes can detect.

We may recall that an atom of titanium (for example) can exist in a great many different states characterized by different amounts of internal energy (definitely fixed for each one). An atom in any one of these states will absorb only a definite group of the numerous lines of the spectrum—the others coming from atoms in other states. For some atoms, such as sodium, there is one "ground-state," much lower in energy than any other; so that, in the ordinary metallic vapor in the laboratory only a very small fraction of the atoms are excited into the higher states, and the absorption by the vapor shows only the "ultimate" lines coming from the ground-state. For others, like titanium, there are many states with energy only a little above the bottom, and light passed through a column of vapor in an electric furnace shows absorption from a number of these states.

But the interstellar lines of titanium are those which come from the very lowest state only. The atoms in states of even a little higher energy must have some way of getting rid of it, and falling back to the lowest level. From most energy levels an atom can do this by giving out an ordinary line of the familiar spectrum, and it is practically sure to do so in less than a millionth of a second, but the transitions from the lower metastable states to the bottom are "forbidden"—which means that they will happen only if the atom is left to itself without disturbance for an enormously long time—such as a second—or even several minutes in extreme cases. The interstellar gas is, however, so very thin that its atoms will go weeks, or perhaps months, on the average, between collisions. So they have plenty of time to settle down, and the observed situation could have been predicted.

For many of the most interesting elements, such as hydrogen, helium, carbon, nitrogen, oxygen, neon, magnesium, and silicon, the lines absorbed by atoms in the ground-state lie in the far ultra-violet, and we have no hope of observing them through the ozone in the Earth's atmosphere — which lies like a black pall upon the dreams of the astrophysicist. There does not appear to be much chance of observing interstellar lines of other elements than those already known. The main reason is that the radiation of the stars tends to remove electrons from the atoms and ionize them, and the chance of picking up electrons again from those wandering about in space is poor. The lines of neutral calcium are much fainter than those of ionized calcium; and Dunham calculates that there are 3500 ionized atoms for each neutral one. Even for iron, which is harder to ionize, only one atom in many hundreds should be neutral.

This explains why we do not find interstellar lines of aluminum and iron. The neutral atoms have lines in good observable positions; but those of the ionized atoms are lost behind the ozone.

In view of all this, it is surprising that a number of sharp, characteristic interstellar lines have been observed and not identified. Their positions, which have been accurately measured, do not agree with the ultimate lines of any known element—and our lists of such lines from laboratory observations are undoubtedly complete (in this region of the spectrum, at least). There must be something else besides atoms in interstellar space, to absorb them.

One naturally thinks of molecules: but at first a great difficulty appeared. The spectra absorbed (or emitted) by molecules are extremely complicated, containing thousands of lines grouped together in bands, often so closely that only the most powerful spectrographs will resolve them. How can such spectra reduce to a few isolated lines such as are observed?

An answer comes by applying the principle already revealed by the atomic spectra—that all the absorbing systems (whether molecules or atoms) will be in the lowest levels of their ground-states.

Changes in the energy-state of an atom depend on changes in the configuration of the electrons in its outer regions. This can happen in a molecule, too, but so can many other things. Even in a simple diatomic molecule, the two atoms may be rotating about their center of gravity; or they may be vibrating, changing their distance on each

side of the mean value. Long series of these vibrational and rotational states are permitted by the quantum rules, and transitions between them give hosts of regularly-spaced lines. When there are only two atoms in the molecule, it is possible, with much labor, to work out just what states of oscillation and rotation correspond to each line. With three or more atoms, the complications are much worse.

Now, when left to itself in interstellar space, a molecule will get rid of its energy (by radiation of forbidden lines), and settle down into a state in which the rotation and oscillation have diminished to the smallest amounts permitted by the quantum laws (which are not always zero). A molecule in this state can absorb only a very few of the host of lines which compose the familiar bands in its spectrum. What is more, the residual line to which the spectrum is thus reduced will not usually be the strongest one in the completely developed band. Which one of the lot it is can be found only when a detailed analysis is made; but for a number of the most important band-spectra such analyses are on record and available.

Utilizing these data, Dr. Andrew McKellar, of the Dominion Astrophysical Observatory at Victoria, has shown that the interstellar line at 4300.24 agrees perfectly with the residual line of the well known hydrocarbon band, which (mixed with other lines) forms the G band in the solar spectrum. Another line at 3874.61 is the sole survivor of the great cyanogen band; and one at 3934.29 can be attributed to sodium hydride.

The agreement of the laboratory and interstellar wavelengths is so good in each case as to afford strong evidence; but more is forthcoming. There are three more accessible bands of the CH molecule, each of which, under interstellar conditions, should reduce to a single line, at 3878.8, 3886.39, and 3890.23. In the spectrum of Zeta Ophiuchi, which shows strong interstellar lines, Adams at Mt. Wilson has found all three of these, in very close agreement with the laboratory positions, and with relative intensities as predicted. His statement, "The evidence for the presence of molecules of CH in interstellar space seems to be conclusive," is none too strong in the circumstances.

Other lines of CN and NaH are also available for a test, but have not yet been looked up; but there is no reason to doubt their presence also. Molecules of other kinds are presumably present, for there are sharp interstellar lines at 3957 and 4233 which are not yet classified. Their identification may have to wait upon a detailed analysis of other band spectra.

There are also three lines in the red, clearly of interstellar origin, but relatively broad, whose origin is still unknown.

These molecules, whose presence has been detected spectroscopically, all look queer to the elementary chemist. He would expect to find CH_4 (methane) instead of CH, and C_2N_2 (cyanogen gas) instead of the half-decomposed CH. The spectroscopist, however, is not surprised. He knows that complete, saturated molecules such as methane have their strong absorption bands far in the ultra-violet or the infra-red, out of reach of the astronomer. (The methane bands observed in the outer planets correspond to weak absorption, which would not show up at all unless the quantity of the gas was enormously great in comparison to what we have been talking about.) Partly dissociated molecules — chemical radicals—which are too active to remain in the free state in ordinary laboratory experiments, often show absorption in the observable region.

It is highly probable that there are ordinary saturated molecules, too, in interstellar space. Common hydrogen (H_2) and nitrogen (N_2) should be there if CH and CN are, and in addition there may be molecules of oxygen and other things as well.

The chemical equilibrium of such a mixture of gases, containing molecules, free atoms, ionized atoms, and free electrons, affords a complicated and intriguing problem for the theorist. We have already some idea how thinly the atoms are strewn. Dunham, a year ago, calculated that in a typical interstellar region, there is one neutral sodium atom for every 20 cubic meters, and one singly ionized calcium atom for seven cubic meters. The neutral calcium atoms are far less numerous—one to 25,000 cubic meters, or 160 atoms per cubic mile, as against 200,000 neutral sodium atoms. Sodium produces almost the strongest interstellar lines, and neutral calcium the weakest so far observed. The number of molecules of CH per cubic mile is probably a few thousand.

To maintain even this small number of neutral calcium atoms, against the tendency of starlight to ionize them, there must be many free electrons—probably at least one per cubic centimeter, or 40 million billions per cubic mile. These must come from ionization of atoms of some sort—probably mainly from hydrogen. Under the assumed conditions, hydrogen would be about 95 percent ionized, which would leave two million billion neutral hydrogen atoms per cubic mile. Only an excessively small fraction of these enter into the observed hydrocarbon compounds. How much carbon, nitrogen, and so on, there may be we do not yet know—but the amount may be roughly calculable, at least, when the problem of the dissociation of molecules under these extraordinary conditions has been solved.

The density of the interstellar gas, measured by any ordinary standards is almost inconceivably small, with one hydrogen atom (or free proton) per cubic centimeter. The density comes out 1.7×10^{-24} that of water, or less than two ounces in a cube 2000 miles on a side. Inside a space as big as Neptune's orbit, there would nevertheless be 600,000 billion tons—one ten-millionth of the Earth's mass—enough (if of suitable composition) to make a big comet or a small asteroid. But inside a sphere of radius equal to the distance of Alpha Centauri, these would be 4.7×10^{32} grams, or almost a quarter of the Sun's mass.

The total quantity of matter in this interstellar gas, on these calculations, is then a considerable fraction of that which is concentrated into the stars themselves. These numbers are rough; and may be greatly altered by later and more precise calculation; but, as they stand, they do not appear very favorable to the hypothesis that the interstellar gas has been ejected from the stars—as eruptive prominences are occasionally driven off from the Sun, and hydrogen and other elements continually expelled from the Wolf-Rayet stars. There seems to be too much of it to be accounted for in this way; and most of it may have been "originally" there—whatever this means.

—Princeton, July 3.

Build No Freaks

Warships Can Be Better Designed To Meet Needs of Their Own Classes

BROCKHOLST LIVINGSTON

For centuries man has sought some revolutionary form of weapon which might overcome all defense. He is still seeking. Both on land and sea, tried forms of warfare have succeeded where novel weapons have failed—no offensive means has ever been discovered that could not be parried. On the sea the ram, the monitor, the dynamite ship, and even the submarine and the airplane have appeared, but defenses against all of these have been developed.

With this nation clamoring for additional defensive equipment it behooves us to move cautiously, to give calm consideration to any proposals for so-called revolutionary weapons. The means we provide for our defense must be the best available but the imaginings of our feature writers should not be permitted to dictate our procurement policy.

In our present quest for the most effective weapons of defense, we are examining, and properly, the possibilities of every type, from tiny motor torpedo boats to Gargantuan battleships. When our studies are completed we shall probably find, as we have in the past, that tried types of weapons both on land and sea must be the backbone of our defenses.

Two schools of thought exist. One has unbounded belief in the efficacy of size; the other in the effectiveness of tiny craft which can dart in unseen, present the minimum possible target, and are capable of rapid production in tremendous quantities. Our real defense undoubtedly lies between these two extremes.

Battleships of 80,000 tons have been suggested. Destroyers have trespassed into the realm of the cruiser. Cruisers, long held within definite limits by naval treaties, are now proposed of a size that gives them the character of the battle cruisers of a few years back but without the strength of such ships. Even submarines have been built so large that they carried armaments greater than that of existing cruisers. Charles Edison, while he was Secretary of the Navy, said that, personally, it did not terrify him to think of a 75,000-ton ship. He expressed his belief that we should provide "crushing weapons with our wealth to protect our wealth."

On the other hand, there are those who claim that one motor torpedo boat, costing in thousands what the battleships costs in millions, can protect us equally as well. Given the proper opportunity, one torpedo from such a small craft can effect the same result as the guns of a many-times more costly super-ship.

Courtesy *Our Navy* Magazine

United States cruisers have come in for much criticism during recent years. Note square stern

In considering what is best for our own defense, however, it must be borne in mind that our problems are not those of any other nation. What may be proper and adequate for others is not necessarily indicative of what we should possess.

The majority opinion is still in favor of the battleship, the most heavily armed and armored vessel which designers can produce. Battleships must be able to protect themselves against every form of attack and, consequently, the torpedo, the mine, the shell, and the bomb are the weapons against which they gird themselves. At one time they had companion battle cruisers, but England's navy, alone, now contains such vessels as a separate category. While the battleship was designed to resist any blow, the battle cruiser was equal in striking power but its higher speed forced a reduction in defensive armament. No ship can be designed to fulfil every requirement of sea fighting, but the battleship, with its relatively slower speed and greater defensive qualities, has heretofore approached closest to the ultimate of ship design.

While we were once content to give our battleships a speed of 21 knots and designed our battle cruisers for around 33, the new 45,000-ton battleships for our Navy are reported to be designed for the higher speed while mounting the same offensive armament of the 35,000 - ton class of 27 knots. Battleships with speeds equal to those of cruisers will almost automatically require that the latter supporting ships be given greater speed if tactical requirements are to be met. Thus we sacrifice some of the primary requirements of the battleship in order to attain the questionable advantage of higher speed.

If every battleship is to be a battle cruiser, then of what is the backbone of a naval force to consist? If it is to be the 80,000-ton ship designed for the greatest possible speed, the heaviest armor, and the greatest striking power, we have arrived nowhere, for such might have been obtained within our 45,000 tons if we had been content with *adequate* speed to fulfil the mission of the type and substituted

heavier armor for weight of machinery.

Our new 35,000-ton battleships carry a heavier armament than any ship in our Navy, have a higher speed and, presumably, are better protected. Ten thousand additional tons on the larger ships have been used to step up speed. Are we headed in the right direction? Would an 80,000-ton capital ship contain any more *legitimate* characteristics of the type than we have placed on our 35,000 tons? These are questions which must be answered.

While we persistently objected to any reduction in the limitation of 10,000 tons which the naval treaties set for cruisers, we were able to provide greater offensive and defensive strength in our ships of this type than any other nation. Now, with treaty limitations a thing of the past, we are talking of super-cruisers of 14,000 and even 20,000 tons. While our battleships have taken on the characteristics of battle cruisers in the realm of speed, our cruisers are tending toward the battle cruiser type in offensive strength. The clear-cut division between types becomes less noticeable with every new ship designed. This trend indicates that the true purposes of the various types may not be very clearly defined in the minds of our directive personnel.

After many years of consistent belief in the need for 10,000-ton cruisers, we recently laid down four 6000-ton vessels of this type and were planning to start a series of 8000-ton craft. The *Graf Spee* battle caused a halt in our plans and the decision to revert to the 10,000-ton type. This decision was arrived at even in the face of the fact that one lesson to be drawn from the battle in question was the need for quantity in this type. Three British cruisers of small size, light armament, but high speed, forced the heavily armed, but slower, German to its doom. The *Graf Spee* was surely a hybrid if there ever was one, and a 20,000-ton cruiser for our Navy would merely repeat the mistakes of this German predecessor. Such types are not for the major sea powers; they are an admission of weakness.

If cruisers are tending to infringe on the domain of the capital ship, destroyers, by their ever increasing size, are stepping up toward cruiser category. We have tended to copy the French and Italian navies with their special problems, and seem to forget the primary purposes of destroyers. Might we not learn a lesson from one day's war news? On a single day, the Allies lost the 1870-ton British *Afridi,* the 2144-ton Polish *Grom,* and the 2436-ton French *Bison.* While, in size, these vessels approached the cruiser classification, they had only the defensive strength of destroyers, and thus fell ready victims to enemy attack. Our own policy toward large destroyers may perhaps be traced back to the day when we lacked cruisers and were required to use destroyers for cruiser duties. They were unsuited, of course, but our new destroyers seem to have been designed to fulfil those same duties while, actually, they should be designed specifically for the tasks expected of the smaller craft.

Courtesy *Our Navy* Magazine

Too big for its class: the French destroyer *Cassard* approaches cruiser class, with a displacement of 2441 tons, seven torpedo tubes, large guns

The fleet vacancy left by the increase in size of destroyers—primarily torpedo carriers — has brought forth the motor torpedo boat. This move is a clear indication of the realization that the destroyer in its legitimate role has out-grown itself. Destroyers must be small enough—within sea-keeping limitations—to dash in to an attack. The motor torpedo boat can fulfil this function in narrow waters and within limited ranges. It does not appear suitable for a high-seas fleet such as ours, but there is an intermediate craft between the huge destroyers now building and the tiny motor boats with which we are experimenting that should meet the situation.

In the last war our destroyers were vessels of 1100 to 1200 tons. Now they are of 1630 and 1850 tons. Due to engineering and constructional advances, it is firmly believed that the smaller ship of today could be made the equal of the larger vessels of the last war while retaining the desired characteristics of the destroyer. The continuing search for a small craft to fulfill the true functions of the destroyer is evidence we have learned little about the type during the past 20 years.

Only in the submarine classification have we shown any reason. We have actually reduced the size of submarines in recent years. We experimented with gigantic craft carrying 6-inch guns, but we are now building an in-between type which seems to be successful. However, these ships are almost twice as large as those we were building when the last war ended. Two of the latter size, on the other hand, are under construction at present—indicating that we are again inclining to the proper belief that a small submarine, in certain situations, is more suitable. The airplane-carrying submarine, the submarine armed with a 12-inch gun, and other freak types which were experimented with in recent years by several nations have all been abandoned in favor of more generally useful types.

Our greatest weakness in submarines is our almost complete lack of mine-laying vessels of this type. We possess only one submarine mine layer and it is the largest submersible ever built for the American Navy. This is a type which has been tried and found successful, and still we have neglected it. It is high time we made up our deficiencies.

No discussion of this nature would be complete without a reference to the anti-aircraft defense of

Courtesy "Jane's Fighting Ships"

World's largest submarine: the French *Surcouf*. Submerged displacement 4300 tons. Carries two 8-inch guns, besides a number of smaller ones plus many torpedo tubes

ships and fleets. Mr. Edison has stated that airplanes have a temporary advantage over ships under modern conditions of warfare. Even if this be true, that advantage can be overcome by proper defense. Protection must be given the gun crews on all types of ships. In this respect, we are now progressing along the right course. Even our destroyers now have at least some of their guns mounted behind shields. The *Wasp*, however, our latest aircraft carrier, was commissioned with her anti-aircraft guns fully exposed to attack. Since attack from the air is precisely the moment when anti-aircraft weapons should be in use, greater protection must be given their crews. The belief that the top-sides of battleships could be shot away and the ship still operated is no longer completely true since the elimination of anti-aircraft weapons might leave the vessel open to fatal damage from attacking aviation.

While additional anti-aircraft defense in the form of protected guns must be provided on all vessels, thought should also be given to the provision of fighting planes as a part of the aviation complements of the larger ships. Ships operating alone or in small detachments must be provided with their own means of defense against aerial attack.

We are now contemplating the conversion of old destroyers into special anti-aircraft vessels (the British have had them for some time). Any such addition to a fleet's ability to defend itself against attack from the air must be encouraged, but reliance upon special vessels for such protection might find the necessary craft in the wrong positions and leave a fleet open to serious damage. The aircraft defense of ships had best be concentrated on the ships themselves.

Even considering these critical remarks, we may rest content that our ships, generally, are today the equals, if not superiors, of similar ships in any navy. Our desire should be to keep them to their present high standard. Adequate defense cannot be obtained by the adoption of freak types. A well-rounded defense consisting of tried types is our salvation. We cannot expect to build the ship in which the characteristics of every type is embodied. We must revert to a policy of clear-cut divisions between types, giving each the maximum striking and defensive strength suitable to it. We must limit each ship to reasonable size in order to avoid too great a loss to the whole when any one is destroyed. In short, we must continue the beliefs of earlier days and avoid, by all means, any tendency toward freakish types, for they have been found wanting in the past and have always been a sign of a weaker naval power. We cannot afford to be considered that.

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U. S. TANKS

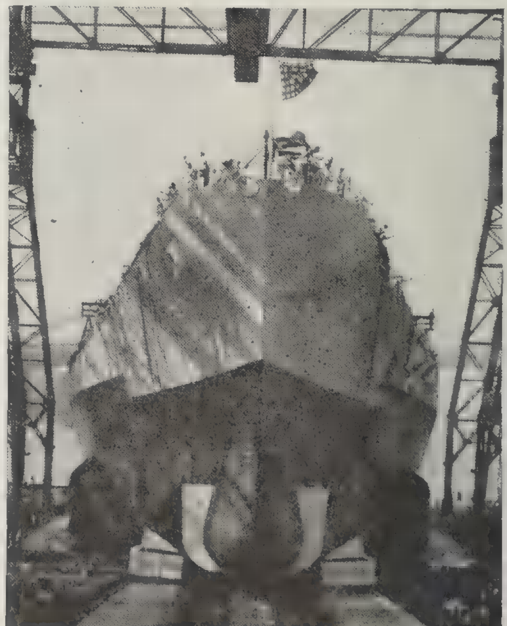
New Armored Corps Modelled After Those of Germany

READERS learned from Captain McInerney's article in the August Scientific American that the tank set-up of the American Army differed greatly from that of the destructively successful German Panzer Divisionen. Since publication of that article, the War Department has announced adoption of tank tactics similar to those of the Germans and the creation of an armored corps of two divisions on an experimental basis. All tanks and other vehicles formally assigned to the infantry and cavalry will be concentrated in the new corps which will consist of more than 18,000 officers and men. The corps will be equipped with 1400 tanks, 600 artillery pieces, and more than 13,000 automatic and semi-automatic rifles, according to reports. This new unit is made possible by a recent appropriation which included provisions for procurement of 3000 tanks for the army. Only about 500 are available at present.

This new, fully mechanized corps will be capable of striking at speeds of 50 miles per hour. It will probably be equipped mainly, according to official comment, with a number of heavy units about twice the weight of present medium tanks. Our Army does not use the 70 or 80-ton monsters such as those in the German and French Armies, and at present there is no suggestion that such tanks might be built by the United States.

"NORTH CAROLINA"

THE photograph below shows the launching of the *North Carolina*, the second of two battleships launched this year, the two marking the first expansion in our battleship force since 1920. The *North Carolina* will be of 35,000 tons displacement and will carry nine 16-inch guns; twelve 5-inch, 51 caliber guns; and eight 5-inch anti-aircraft guns; and four airplanes and two catapults. She will be approximately 35 percent welded instead of riveted, thus saving weight which can be utilized in other ways. Her cost will be an estimated $65,000,000.



Courtesy *Our Navy* Magazine

Launching the *North Carolina*, second of two launched in 1940

OUR *Point* OF VIEW

"ALL-AMERICAN" WAR

PROPAGANDA is a wondrous thing. It has made of Hitler, according to the welcoming phrases of German newspapers when he recently returned from the Battle of France: "A Genius for Commanding," "The Lord of Battle," "Leader from Darkness to Light." It has made of him a legendary hero of the proportions of a Napoleon and a Caesar rolled into one.

It will, however, help the logical processes of American thinking in developing our national defense if we remember that Hitler is but a man. Hitler does not direct the tactics of the German Army. Men trained in the science of war do the commanding. It is even doubted in some quarters whether it is his decision which unleashes the might of the Nazi columns according to the plans worked out by his military chieftains. Theirs is the knowledge of war; theirs must also be the knowledge of precise timing.

But he has brought to war so many new weapons and methods? Has he? Definitely not. The blitzkrieg is about as old as war, but Sherman's march to the sea is sufficient as an example. Only the speed is new. Tanks in large numbers? Hannibal had his herds of fighting, warrior-carrying elephants. And the tank is but a British adaptation of the commercial tractor developed by Americans. Airplanes are, of course, from an American invention. Dive-bombing is wholly American. Parachute troops? One radio commentator, whose authority we can trust, claims priority for the American Army in that tactic — even over the much-publicized Russian parachute experiments. But, we hear, the Germans are geniuses for industrial efficiency. Are they? They have but followed American technique for industrial planning and organization — a technique in which we lead the world. Indeed, mass production, as a system, was invented by an American: Eli Whitney, of cotton gin fame.

"Plan" is the whole secret of German success in war — plan, organization, co-ordination. And don't forget starvation — the tightened belts that made possible their tools of war. Hitler is not the secret. He is only the figurehead, the angel with wings of propaganda and feet of clay. It is German planning and doing and sacrificing that the world must beat. So far as American national defense is concerned, we *can* beat it hands down — and a dozen times over. Are we going to do it, or sit back, play politics, and say "What's the use? Hitler is invincible"?—*F. D. M.*

HOT OR COLD

WILL hot water freeze faster than cold water? An excerpt from *Science*, printed on the "Browsing With The Editor" page in our August issue, says "No." This answer to an age-old question promises to stir up one of those minor controversies that make interesting speculation.

Offhand, logic would plainly indicate that cold water should freeze faster than hot; both must be cooled to zero, centigrade, and logic dictates that the temperature differential is such that cold water will reach this point long before hot water. But may not this be one of those occasions in which logic is so plain as to lead the logician astray?

Such may be the case. Conflicting experimental evidence has been produced to answer the question both ways: hot water freezes first; cold water freezes first. Plumbers tells us that the pipes carrying hot water in homes will burst (but not necessarily freeze) before the cold water pipes, when exposed to low temperatures over long periods of time. But it has been rather definitely settled that this phenomenon involves the question of differences in quantity of dissolved air in the two systems.

What are the facts when the hot and the cold water are subjected to low temperatures under identical and controlled conditions? The family refrigerator, mixtures of ice and salt, the cold-storage box of the neighborhood butcher — all offer experimental possibilities.

No world-shaking revelations are promised by the answer to the question, but the editor will entertain the thought of publishing submitted results of controlled experiments made by readers. Here is a question that should be answered once and for all, if for no other reason than to prove or disprove the soundness of logic applied to a simple problem.—*A. P. P.*

LIGHT

"PEOPLE'S eyes never were intended to stand the more and more powerful illumination they are using today."

"You've complained of tired eyes, yet now you install a big 100-watt lamp only 18 inches or so above your desk to tire them faster. It isn't intelligent."

The desk really did seem pretty bright with the new lamp in its deep reflector; and it kept on worrying office callers. "Why, that's brighter than the sun," they said.

One day in May, when the sun crept high enough in the sky to shoot a brief noonday pencil of light down through one of New York's canyons and directly on the desk, overlapping part of the lamp's illumination with a sharp demarcated area of its own, the facts came vividly and literally to light: The lamp-lighted area, considered too bright by callers, now seemed only dusky by comparison. It looked like deep shadow.

The sun's light approaches 10,000 foot-candles but take 5000 as something like the natural outdoor level under which human eyes evolved. For regular reading, it is, however, pretty strong.

The science of seeing, according to its ablest authority, Dr. M. Luckiesh, Director of General Electric's Lighting Research Laboratory, reveals evidence that you could read this printed page easiest at 100 to 1000 foot-candles. As a temporary compromise it recommends at least 50 to 100 for difficult reading and 20 to 50 for ordinary reading.

It's easy to underdo working illumination — hard to overdo it. On lighting, the world is steadily learning a new set of values — higher. Ultimately, they'll go much higher, in accord with good science.—*A. G. I.*

Mud, Concrete, and Oil

Drilling Mud, Treated Like a Favorite Child, Makes Possible Wells Miles Deep

ANDREW R. BOONE

In the summer of 1858, Col. Edward L. Drake, a former railroad conductor willing to gamble on a strange new venture, started the first test bit into the earth at Titusville, Pennsylvania. He drove down a 36-foot casing and, using a wheezy six-horsepower engine, drilled inside the pipe. At a depth of 69½ feet, the Colonel discovered oil for the first time in history, and shortly thereafter sold his output at 60 cents a gallon.

Across the continent in sun-baked San Joaquin valley, near Wasco, California, a diminutive tool pusher named Louie Hopkins recently completed, for the Continental Oil Co., his ninth hole deeper than 13,000 feet. One of the wells drilled by Hopkins, the KCL-A2, hit bottom at the world's record depth of 15,004 feet, 215 times deeper than Drake's discovery. Whereas Drake's "Folly," as envious diehards dubbed the first exploration 82 years ago, barely pricked the earth's surface, in nine tries Hopkins has directed the bit downward a total of some 22 miles. From his deepest well oil is flowing upward more than 2½ miles. Instead of 60 cents a gallon, this oil, brought in at a cost of $300,000, fetches on the current market less than the small sum of three cents a gallon.

Checking specific gravity of mud returned from circulation

Diamond-tough drilling steels, borers ranging from bomb-like structures to rock smashers consisting of cones which rotate within revolving bits, new and more powerful steam engines capable of shoving mud down inside the drill pipe and thousands of feet upward again, basket-like cement plugs and pipe whose threads will not pull apart under the tremendous weight of 500 tons, make it possible to reach deep sands and bring their loads of black gold into production.

Mud testers and cement mixers make possible fast drilling and completion of wells uncontaminated by water and sand. On every deep-test rig you'll find a mud engineer on the job constantly. Drilling mud is a mixture of water and some powdery non-metallic mineral, such as gypsum, often fortified by several chemicals, including chestnut extract and quebrach. It is pumped down inside the drill pipe, out through the bit and up between the pipe and the walls of the hole. It must keep moving, carrying up cuttings, lubricating the pipe, and preventing cave-ins; otherwise the drill pipe will stick and the hole be lost.

Hopkins knows mud and treats it like a favorite child, for this sticky substance has given him an enviable record. He starts it down weighing exactly 95 pounds per cubic foot. After it has mushed through deep shale hot enough to boil water and has picked up a load of gas, he runs it through a series of paddles operating in vacuum, and returns it to a nearby pit to await the next trip down. The agitator removes the gas and reconditions the mud.

When at last the bit penetrates oil sand, cement men drive up with their mixers and prepare to wall off any water which may leak down

Expanding brass baskets keep concrete from below the casing

When concreting a deep oil well, men must work at top speed. The mix must reach bottom and return outside the casing before it begins to set

The wooden blocks that are used when concreting a well

from upper formations. Two plugs and an expanding basket make possible effective shut - offs. The basket is lowered to the bottom, and expands when concrete begins to press against its insides. This prevents the mix from moving down into the oil formation. A wooden block containing a hole through which the concrete may escape slides down the casing, following the basket to bottom. After the block goes a column of concrete, followed by an upper block which separates the concrete and the mud which powerful pumps force down against the upper block.

Not long ago a cement crew slashed open 1400 sacks and forced the mix downward, cementing a California well 11,000 feet deep in 30 minutes, 30 seconds. That was one record. "Shucks," commented the foreman of another crew next day, "we placed 2000 sacks in 24 minutes, 40 seconds." What he meant was, 50 workmen had prepared the mix, and two batteries of pumps had forced the gray slush down more than two miles and up 4200 feet between the casing and rocky walls of the hole in that time. Meanwhile, to prevent a jam, the cables had been picking up and lowering 425,700 pounds of drill pipe in 15-foot steps, as easily as you lift a kitchen chair.

Wells four miles deep are a definite possibility during the next few years. May they go on down farther to unexplored horizons, tapping little-known sediments that were laid down in remote geologic ages?

Colonel Drake little dreamed that his 25-barrel production would multiply by millions. He batted .1000 by bringing in a wildcat when friends and relatives hooted at his wild dreams. Louie Hopkins batted .666 on his nine deepest wells, but the six flowing today came in with 440 times more oil than the colonel found. Louie is ready to try his luck with a four-mile hole. All he wants is a good head of steam, enough pipe to reach bottom and a mixture of mud and chemicals which he knows from experience will keep the rig turning until he gets there.

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Under Mobile River

Vehicular Tunnel Built On Land, Floated Into Place, Shows Engineering Advances

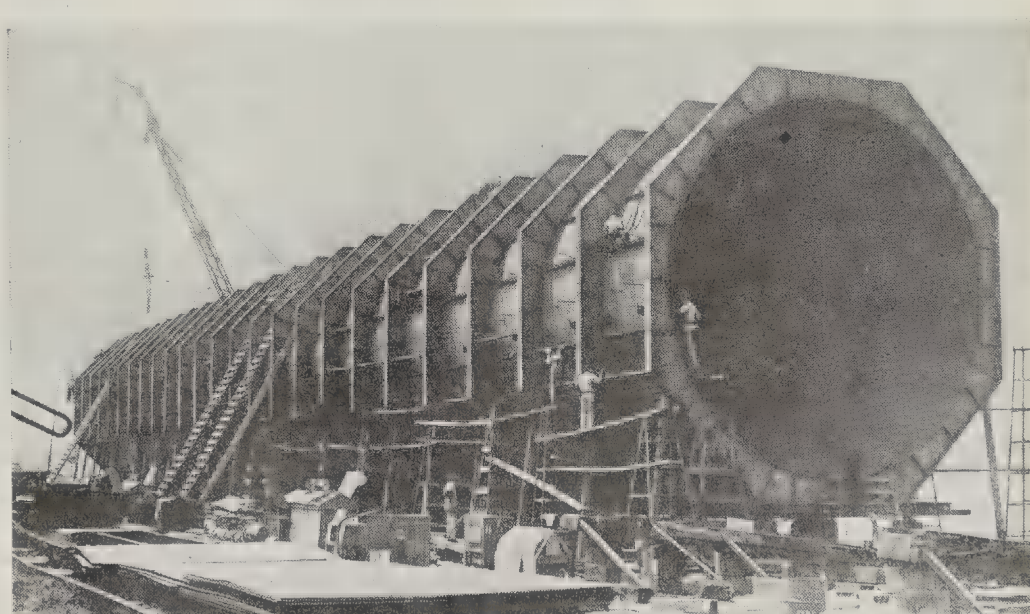
R. G. SKERRETT

MOBILE, Alabama, on the much traveled old Spanish Trail, has built, at a cost of $4,000,000, a different type of subaqueous tunnel for the convenience of automotive traffic. The tunnel will shorten the east and west route by 7½ miles, and will materially reduce heavy traffic congestion.

Mobile is at the mouth of Mobile River and at the head of Mobile Bay at a point 30 miles inland and north of the Gulf of Mexico. The city is Alabama's historic and only seaport. It is on the west bank of the stream, opposite Blakely Island.

Work on the Bankhead Tunnel, as the river underpass is called, was started in July of last year. It links Mobile with Blakely Island and connects with a 10½-mile causeway extending eastward from the island and spanning several narrow water gaps.

The under-water sections of the tunnel were built at a local shipyard, launched one by one, towed to a nearby slip on the west side of Blakely Island, and there brought to a stage of near completion before being moved to and sunk in a deep trench dug in the river bed. Five of the seven sections are each 298 feet long, and the two other sections are each 225 feet long. The under-river structure has a total length of 2000 feet; and near each shoreward end there is a transition section which connects with a rectangular or box-like section of the tunnel. At the Mobile end, an open ramp approach extends downward from the street level to the portal of the western section. On Blakely Island, the steel box section runs right up to



Partly finished steel framework of an under-river section. Steel plating covered the outer octagonal ribs, and concrete filled the space thus made

The top of the outer shell of this tube at Blakeley Island is open so that workmen may install wiring conduits, pour the concrete, and so forth

the ground surface, and is equipped with a steel gate which may be closed, in time of hurricanes, against water piled up on the island. The Bankhead tunnel has a total length of nearly 3390 feet between grade levels, and its roadway is 21 feet wide for two traffic lanes — eastbound and westbound.

The Bankhead Tunnel is similar in principle to the Detroit Tunnel, built in 1930, but differs in a number of particulars which represent engineering advances. Each tubular section of the under-river divisions is made up of an inner steel cylinder 30 feet in diameter surrounded by an octagonal steel tube that has a minimum diameter of 34 feet. The two concentric tubes were tied together by equidistant radial ribs, and the spaces between the two tubes filled with concrete before being finally sunk in the trench and covered. The inner tube of each section is lined with reinforced concrete not less than 18 inches thick. The top of the tunnel, in mid-channel, is about 46 feet below the level of mean low water.

Each end of each tube was sealed temporarily with a watertight steel bulkhead before launching; and concrete was poured into the inter-tubular space to a height of 10 feet to give each section stability when it was first launched. Steelwork was put together by welding; and, before launching, each tube was coated with soapy water and subjected to internal air pressure—any leak promptly blew tell-tale bubbles.

At Blakely Island, openings were cut in the top plates of each inner tube to give temporary access to the inside of a section so workmen could place the concrete lining, the conduits for power, lighting, and telephone circuits, the roadway slabs and the ventilating duct beneath the mid-section roadway for a distance of 400 feet. That done, the access hatchways were sealed, and the sections, starting at Blakely Island, were floated to the trench and sunk.

At the trench, the last of the concrete was poured into the spaces between the inner and outer shells until a section lost its buoyancy. It was held suspended in a sling and lowered deliberately. Succeeding sections were brought together by pulling the newly laid section, with ratchet turnbuckles, snugly against one already installed. A projecting ring on one fitted into an annular recess filled with a rubberized gasket on the other. Divers did this work. Later, the joint was covered on the outside with concrete poured underwater. Finally, when bulkheads were cut away, adjacent inner tubes were tied together by a welded ring of steel.

One ventilation building, on Blakely Island, is equipped with exhaust fans only which suck vitiated air into ports on both sides of the roadway level for 400 feet in the mid-section of the river part. No fresh air is blown into the tunnel, but the action of the fans at the low point is counted upon to draw fresh air inward and downward from both portals and maintain proper circulation. This arrangement is based upon experimental work of the U. S. Bureau of Mines. An unusual feature of the illumination is that, while lights are arranged to give proper illumination at all points in the tunnel, special additional lights are installed near each portal. These latter lights burn only during the day, their purpose being to make the transition more gradual for the eyes of the driver as he enters from the strong outside sunlight.

ROAD PROTECTION

Bags of Green Concrete Laid as Rip-rap

ONE of the most troublesome problems of road building and maintenance is that of protecting slopes against erosion. Where run-off is rapid and in large volume, it is practically impossible to start sufficient plant growth to root the soil in place. In such cases, engineers often resort to use of rock rip-rap. In California, on some sections of highway, engineers are making their "stones" and, in addition, are making them so that they dovetail.

Because of bad wash-outs along highway slopes, and particularly where the water action is of such tremendous power that boulders five to eight feet in diameter are carried away, the slopes are being lined with bags of concrete. As an accompanying picture shows, these bags are filled with green concrete and then laid on the embankment in even, horizontal rows. In their damp state, the filled bags press down, one layer upon the other, so that when they harden, they fit into and hold each other tightly. The finished slope presents a pleasing appearance that could never be attained by use of rough stones.

Engineers are watching the results with this form of slope protection, for it is believed that it will be superior to ordinary rip-rap.

Man-made "stones" protect road

BROWSING with the Editor

THROUGH THE SCIENCE LITERATURE OF THE WORLD

IDAHO WHITE PINE SUPPLY—White pine is being drained from the famous Idaho forest lands two and a quarter times faster than Nature restores it. By replanting now, stopping fires, and cutting timber scientifically, we can make restoration balance use in five decades.—"Forest Increment in North Idaho," U. S. Forest Survey Release No. 18.

HIT BY CARS.—In one group of pedestrian fatalities caused by automobiles in Wisconsin, 81 percent of the victims were unfamiliar with the operation of the vehicle which caused their deaths. Doubtless this condition is general, for Connecticut reports 94 percent of pedestrian fatalities were people not licensed to drive.—*Highway Research Abstracts,* July, 1940.

PLANES BY THE POUND.—The thousands of warplanes Uncle Sam is ordering for defense will cost about $7.50 a pound. The announced goal of 50,000 a year means the production of over half a billion pounds of airplanes, engines, and propellers.—*Science Parade,* July 13, 1940.

LIGHT AND ACCIDENTS.—The National Safety Council estimates that 5 percent of industrial accidents—in other words, $75,000,000 worth—are caused by poor light.—*Industrial Bulletin* of Arthur D. Little, Inc., Number 153.

RENTED AIR CONDITIONING.—An air conditioning system that can be rented by the day or evening, along with the auditorium it serves, has been installed in the Jewish Community Center in Detroit. Ice is used to provide cooling during periodic uses of the system.—*Refrigeration and Air Conditioning,* June, 1940.

FURNACE RECORD.—A blast furnace of the Otis Steel Company has probably achieved the record of operating for the longest period of uninterrupted use ever obtained on a single blast furnace lining. From May 1930 to May 1940 it operated continuously without being blown out, producing in that 10 years 1,735,500 gross tons.—Hill & Knowlton notes, May 17, 1940.

STRAIGHT ROAD.—An Italian "autostrad" across North Africa has one stretch 400 miles long without a sharp turn. —W. C. Lowdermilk, *American Forests,* July, 1940.

SHIP UNLOADING.—Ships that unload themselves with the aid of belt conveyors, which have been in use for more than 20 years on the Great Lakes, are beginning to win acceptance on the Atlantic Coast, where the second ocean-going vessel thus equipped has recently been put into service.—*Oil-Power,* July, 1940.

FOREST FIRES.—It is not improbable that, in the daylight hours, an average of one forest fire is set every two minutes in the United States—probably every minute during the vacation months. This is an indictment of people who are careless in the use of tobacco, because that is the cause of most of our forest fires.—*News,* New York State College of Forestry.

LOCOMOTIVES.—The American railroads have 46,544 locomotives, of which number 45,210 are operated by steam, 882 by electricity and 452 by gasoline or oil.—Association of American Railroads.

CONSERVATION FOR DEFENSE.—Conservation today takes on new importance because of the urgency of national defense. A country's natural resources sustain its defensive and combatant power. This is true of forests no less than oil and other natural resources.—*American Forests,* July, 1940.

ARTIFICIAL RUBBER COST.—The cheapest commercial "synthetic" rubber today costs about twice as much as the natural product.—Lawrence A. Wood, Ph.D., Circular C427, National Bureau of Standards.

SILICOSIS.—During 1939, 91 miners were certified to have died of silicosis and 355 certified to have been disabled by the disease in the South Wales coalfield.—*Nature* (London), June 22, 1940.

AIRPORT PAVING.—The new Washington, D. C., airport will have a total asphalted area, including four huge runways, parking areas, and roads, equivalent to 83 miles of highway 18 feet wide. What is purported to be the world's largest airport, in Newfoundland, has the equivalent of 116 miles of 18-foot asphalted paving.—*American Petroleum Institute,* July 7, 1940.

ON THE 'PHONE.—Americans, person for person, telephone 14 times more often than the rest of the world. Furthermore, this country has about half the world's telephones, and makes something like 1000 calls a second.—*Telephone News Bulletin,* May, 1940.

INDUSTRIAL ALCOHOL.—Approximately 198,467,000 pounds of corn and 202,631,000 gallons of molasses are annually manufactured into industrial alcohol.—*Monsanto Magazine,* May, 1940.

SHOCKING EELS.—An electric eel may discharge as much as 1000 watts of electricity at a voltage of 600 This discharge is at the frequency of 200 or 300 times a second. —*The Lamp* (Standard Oil Company of New Jersey), April 1940.

MORE SOYBEANS.—Soybean production in the United States has multiplied 22 times in the past 15 years, 17 times in the past six years.—*American Chemical Society.*

BULLS SEE NO RED.—The popular idea that bulls fight when they see red has long been exploded. The bulls are color-blind. It is the movement, not the color, that infuriates.—*Science Parade,* May 6, 1940.

EXPLOSIVES BY RAIL.—Railroads of the United States and Canada in the past 13 years have transported billions of pounds of high explosives, including dynamite, black and smokeless powder and explosive ammunition, without accident, death, or injury.—Association of American Railroads.

STOP AND GO.—A mere 15 years ago, a green light on Fifth Avenue, New York City, meant "stop," yellow meant "go," and red meant "caution."—*Science Parade,* May 4, 1940.

AUTOMOBILE EXHAUSTS.—Gasoline burning in automobiles produces enough carbon dioxide in a year to make 160,000,000 tons of "dry ice."—*The Lamp* (Standard Oil Company of New Jersey), April 1940.

Helicopters

Rotating-Wing Aircraft Exhibit Desirable Characteristics for National Defense

ALEXANDER KLEMIN
Aviation Editor, Scientific American. In charge, Daniel Guggenheim School of Aeronautics, New York University

THE writer of these notes has been criticized for allowing the school of aeronautics with which he is associated to give real attention to rotating-wing aircraft at a time when the airplane is so important as a means of national defense! But is it not possible that rotary-wing aircraft—autogiro or helicopter—will also serve most usefully in national defense? At least a wise and experienced engineer—Igor Sikorsky—is of this opinion, and voiced his views strongly and persuasively at a recent meeting of the Society of Automotive Engineers.

The airplane, by the nature of its design, will always be faster than the helicopter—say 500 miles an hour against a potential 300 miles an hour for the rotating-wing craft. However, for defensive military purposes the helicopter can perform in a number of ways which are impossible for the airplane. Let us quote Mr. Sikorsky.

"For example, to interpose an effective defense against bombers or dive bombers, the helicopter seems to me to be ideal. It can stand still in the air, thus affording a stable gun emplacement from which the gunner can await the moment—which must come either in altitude bombing or dive bombing—when the bomber ceases all zig-zag maneuvering and flies a straight line for its quarry. Then the bomber is comparatively easy to hit. The helicopter, of course, can easily have altitude performance up to 15,000 feet or more and can carry large-caliber machine guns or even cannon."

The helicopter can also remain poised above strategic spots. It can evacuate the wounded, particularly at night. By descending within reach of the ground to pick up man and litter, the helicopter can act as a perfect air ambulance. Again, said Mr. Sikorsky, "once launched from a battleship or cruiser the airplane can be recovered only by alighting on the sea, if it is smooth enough, while the craft is lifted aboard. Obviously, in battle, major units cannot stop to pick up aircraft even if conditions of wind and water make this possible. The helicopter however, would require only a platform or deck space of about 40 feet square from which to take off and on which to land. It could follow every dodging movement of the surface craft, flying backwards, sideways or forward at will and always itself afford a steady firing point for its defensive guns."

Landing gear for the helicopter would be rubber bags rather than wheels and on these bags the machine could use land, water, ice, snow, a vessel, or a building for a take-off or landing. Pilots could be trained to fly a helicopter with relative ease.

Mr. Sikorsky has made a logical and strong plea which should not be forgotten.

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AIRSHIPS

Still Hold Possibilities for Military Purposes

GENERAL opinion, public and aeronautical, is that the airship is dead, that it is too slow and vulnerable for fighting purposes, too slow for transoceanic passenger work when the Clippers can fly three times as fast. The Navy Department does not agree with this view. A special board on the lighter-than-air situation reports to the effect that in spite of all disasters and speed inferiority, relatively small rigid airships should be built.

With its ability to carry airplanes, the rigid airship can be best compared with a cruiser or an airplane carrier. The cruiser is capable of about 30 knots sustained speed for three days; the modern airship can deliver 60 knots for six days. The airship can be conceived as an airplane-carrier immune to mines, torpedoes, and submarines, which could well proceed overseas and, lying well off an enemy coast, launch a successful airplane attack. The airship would be most useful in long range observation, scouting, reconaissance.

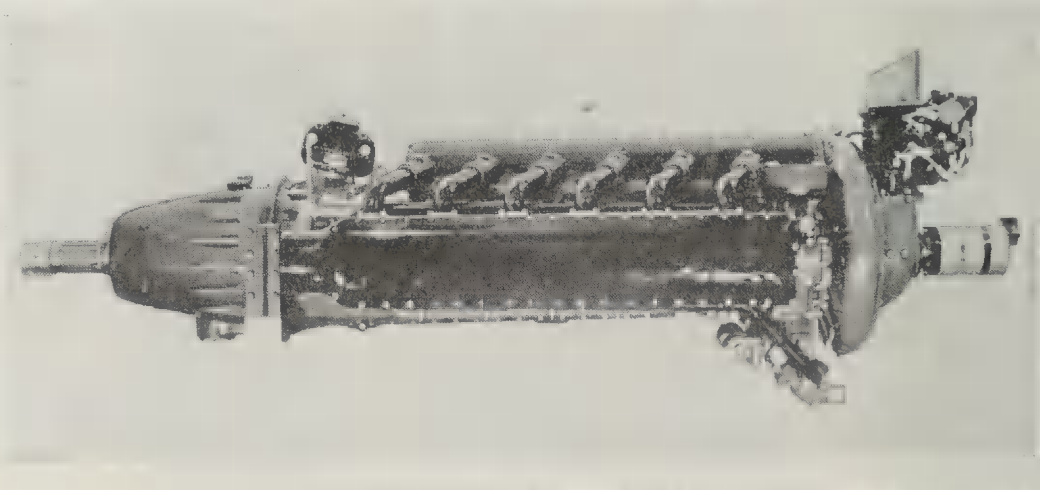
Of course, we could cite many arguments against further airship effort. But to build a small dirigible of 3,000,000 cubic-feet capacity, at a cost of $3,500,000 for training of personnel and experimental purposes is an idea worth considering. —*A. K.*

ENGINE

"Submerged" Design Increases Flying Efficiency

AS the drag of landing gear, external supports, and even of the fuselage is reduced, and the airplane approaches the ideal of the "flying wing," it becomes more and more important to eliminate the drag of exposed engine nacelles.

Two views of the "submerged" Lycoming engine for aircraft



Designers advocate the "submerged" engine—that is, an engine which is enclosed completely within the wing—and argue that the hidden engine will decrease fuel consumption and increase speed. Now, the Lycoming engine division of Aviation Manufacturing Corporation has produced a novel "flat" engine which should meet with immediate application in our military and naval aircraft.

The Lycoming flat engine is illustrated in two of our photographs. There are 12 cylinders, six on each side of the crankshaft. The over-all height is only 37 inches compared with the 49- to 54-inch diameter of the conventional radial air-cooled engine. The low frontal area and low height makes it perfectly feasible to house the engine completely within the wing. Of course, the problem of airplane balance has to be met, since the weight of the radial engine is located quite far forward, relative to the rest of the airplane, but designers will meet the situation. Also, the flat engine, being liquid cooled, has to have a radiator. But the radiator can be filled with Prestone which operates at a much higher temperature than water, and hence the radiator can be quite small. Further, the radiator can be ducted or streamlined partially in the under side of the wing.

Altogether this is a praiseworthy and promising development, which comes at the right time in the national defense emergency.—*A. K.*

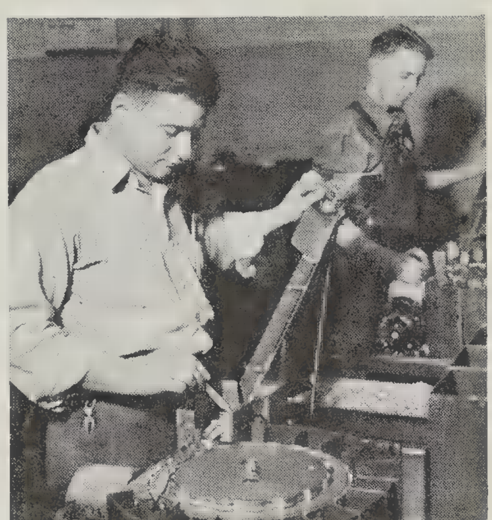
RIVETS

Salvaging Methods Cut Costs in Airplane Assembly

PRODUCTION engineers of the Glenn L. Martin Aircraft Company long ago discovered that it was cheaper to let lie the rivets dropped accidentally on the airplane assembly floor than to have operators take time out to pick them up. The riveter's time is valuable; a skilled worker is expected to drive 1000 rivets a day. Nevertheless, dropped rivets represented a real problem, since a pound of aluminum rivets costs approximately one dollar, and some 60 pounds of the rivets were swept up every day. A team of boys used to sort out the rivets by hand, but it was slow and uneconomical work to separate the round-head and flat-headed rivets and those of varying lengths and diameters.

Now the tool designers have developed a rapid, semi-automatic process. An electro-magnet is passed over the floor sweepings, snatching up extraneous steel and iron material. The residue is chiefly rivets of some 150 different kinds. Next, a series of sifters sort out the rivets for diameter in much the same way as gravel is graded. Then a mechanical device separates the rivets for length; the rivets travel around the perimeter of a wheel until they are knocked off by the length gages. To expedite the process further, a little hand-operated machine has been developed which serves to separate round-heads from flat-heads. The round heads drop out first, the flat heads next.

Obviously, our tool designers will play a not insignificant part in the national defense effort.



Steps in salvaging rivets. Lower left: Sorting for diameter with sifter. Above: Sorting for length. Below: Separating round-heads from flat-heads

Side view of the Ercoupe, practically spin-proof

UNCONVENTIONAL

Combined Features Make Spin-Proof Airplane

WE have for several years been of the opinion that all the aerodynamic factors required to give us a spin-proof airplane were already available. A new, somewhat unconventional airplane, the Ercoupe, seems to come near to this safety requirement. At least no inspector of the Civil Aeronautics Authority has been able to spin the new machine.

While the wing of the Ercoupe is thick throughout, and is externally unbraced, it is rectangular in plan form — there is no taper With a sharply tapered wing, the tips stall first. With a rectangular wing it is the center section which stalls first. Moreover, the leading edge of the center section is brought down to a sharp V, and this again tends to make the center stall first. With the center stalling first, there is no tendency to fall off on one wing — an initial step in the spin. Again, the two rudders are quite clear of the fuselage, being carried at the ends of the horizontal tail surface. Therefore, at high angles of attack, with the nose pulled up sharply, the vertical surfaces are not blanketed in any way, and retain their full effectiveness.

But there is still another factor which is a spin safeguard for the novice pilot. The upward travel of the elevator, which of course tends to raise the nose of the aircraft, is strictly limited. Thus the novice cannot readily put the machine in a stalled attitude.—*A. K.*

No Short-Cut Horticulture

Plant Growth Chemicals Require Painstaking Care, Promise Significant Results

PHILIP H. SMITH

THERE is a widespread impression that chemistry is leading horticulture and agriculture into a new era, marked by the abolition of the hoe, the wheelbarrow, and the spraygun. Given a pill or a powder and the novice will become an expert overnight, flowers and vegetables will increase from half-dollar to dinner plate size, and meals will be plucked from fire-escapes. But why go on?—your imagination is as good as mine.

Plant chemicals can accomplish wonders. Some make possible plant growth in water solutions, quite remote from soil; some will stimulate root growth on cuttings; others will make fruit form without pollination. There is one chemical which induces root growth on backward plants, and another which enables the hybridizer to create new varieties which nature might never get around to do.

In reporting these wonders, scientists have given fact, not fancy, and no further confirmation is needed. All fact can be visually substantiated in this or that laboratory. But the layman asks the significance of all this to him. "Can I," he says, "get results with the chemicals? Is water culture commercially feasible? Can grandma's begonia be reproduced by a tyro?"

At the risk of posing as an old meany, I must declare that horticulture is about where it was before the advent of these chemicals, except that there are probably more bugs in the world. But the use of chemicals introduces something new, promising, and anchored in scientific fact. It offers means to experimentation and acquisition of knowledge about plants; it promises little ease and less profit.

Gardening without soil, variously called tank culture, tray-farming, and hydroponics, has developed fast and in a number of directions. There is now great variety in form and composition of tanks, in the constituents of the nutrient, and in the method of feeding. Experimenters seem to favor the system known as gravel and cinder culture. Here, the plants actually grow in gravel or cinders and are fed periodically by subirrigation.

Successful tank culture calls for sunlight and air. These elements are quite as essential to growth as in soil culture. Thus an immediate requirement is outdoor or greenhouse location, and whatever the solution fed, it must be properly aerated. Temperature, too, is important and for best results there must be a carefully controlled differential between air and solution temperatures and between day and night temperatures. Once the general procedure has been determined, there remain such technical problems as: character of water used, acidity of the solution, proper replenishment of salts in the nutrient to replace unequal consumption by the plants and losses by precipitation, toxic effect of tanks and beds, and the precise timing of every operation.

Science Service photograph

Colchicine doubled the chromosomes in this peach tree at Beltsville, Maryland

Gravel and cinder culture is recommended as having these advantages: elimination of cultivation, watering, weeding, fertilizing, soil changes, and many soil-borne diseases; control of the type of growth; and virtually automatic operation. However, these advantages must be weighed against the cares outlined in the foregoing paragraph to determine the net gain, even assuming profitable operation. Some people prefer scratching the soil to reading thermometers, minding valves, or keeping accurate records.

The number of persons operating commercially successful hydroponic farms can be counted on your fingers, although the number will doubtless increase. It is a highly exacting and specialized performance and at this stage its costs are such as to limit its practical possibilities to areas where out-of-season crops demand premium prices, where there is lack of good soil, or where the soil is so poor that it takes heavy outlay to keep it at par. Certain geographical sections are unsuited to hydroponics because in off-season, when crops are wanted, the sunlight is inadequate.

DEVOTEES of hydroponics declare that tomatoes have been raised successfully in water solution and the fruit is of superior quality. This is true. But it has not been proved definitely that the same care and control applied to soil culture would not produce a comparable crop. The successful hydroponitian is a man who has acquired an intimate knowledge of the plant he grows—its habits and climatic needs, its mode of propagation, and the control of pests and diseases—usually from previous soil culture.

The uninitiated believe the critical factor in hydroponics to be the chemical formula, but this is secondary to the facts just mentioned. The problem of what to feed has been pretty well solved and formulated chemicals can be bought in the market. Of the several formulas in use, there is little variation. A good all-around composition calls for potassium

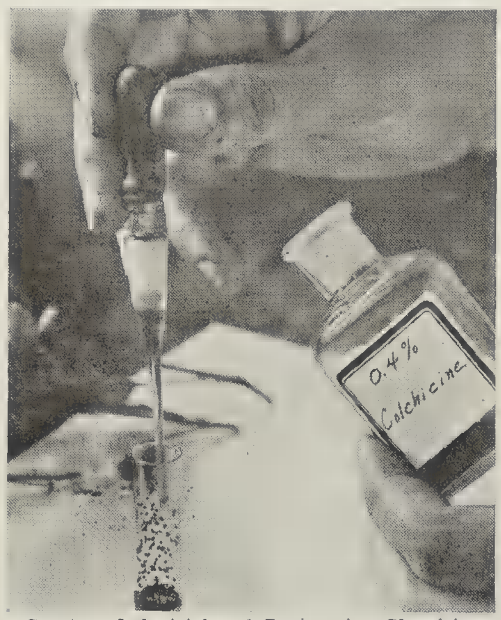
phosphate (monobasic), potassium nitrate, calcium nitrate, and magnesium sulfate, to which is added minute amounts of iron, boron, manganese, zinc, and copper. Waters differ greatly as between geographic areas, hence the experimenter must modify basic solutions to obtain proper salt content if he would obtain good results.

Far more interesting than the water-solution chemicals are the hormone-like substances which modify or regulate plant growth. These chemicals are called "hormone-like" because they are substances thought to act like unknown plant hormones. They are not laboratory syntheses as is widely believed. As a matter of fact, those which induce root growth have never been found in plant life. There are some 50 of them known to scientists as being capable of playing tricks on plants, but there are only three in common use today. These are naphthalenaacetic, indoleacetic, and indolebutyric acids. Of these, the last named has proved most satisfactory because it is effective over a wider range of concentrations.

THE root-inducing power of these chemicals is unquestionable. If they are applied to leaves or flower stalks, for example, roots will grow from the places touched. The immediate, practical value of these substances is in the propagation of plants and shrubs from cuttings, either to hasten the process of root formation or to make roots grow on cuttings of species ordinarily non-rooting. Common practice is to dip the basal end of cutting in a solution of indolebutyric acid for 24 hours, or to dust with a powder composed of hormone and talc; otherwise propagation technique remains unchanged.

It would be a serious mistake to assume that these substances are infallible because they have had certain unparalleled success. Combined with the capacity to induce roots, is a like power to retard growth and inhibit bud formation. Sometime the technique may be worked out to take advantage of these added powers, but at present they impose care lest too strong a concentration kill the entire cutting. Root inducers do not eliminate the seasonal factor in propagation, nor will all species respond to their coaxing. Every variety of plant or shrub has its own peculiarities which must be given consideration. In general, leafy cuttings respond much better than hardwood cuttings, whatever the species.

The hormone-like substances can do more than induce root growth. Artificial stimulation of fruit—that is, the formation of fruit without pollination—is one of the achievements. The classic example is the manufacture of red berries on the American holly. When the male tree is too far from the female tree to permit transfer of pollen, no berries are formed from the female flower. Here



Courtesy *Industrial and Engineering Chemistry*
One way of drugging a plant: treating seeds with colchicine

naphthaleneacetic acid comes to the rescue. Spraying the flowers with a solution of the acid will cause berries to be formed. They will be seedless, but who cares at Christmas. The practical value of this treatment is another story. The acid costs more per ounce than gold, and the most economical solution to the production of red berries would seem to be to plant more male bushes. However, this type of experiment hints at the future production of seedless fruits and vegetables—seedless tomatoes, for example, for persons allergic to tomato seeds.

Experimenters report success in the use of these chemicals for restoring the viability of seed. This would be a boon to seedsmen, not to mention the backyard gardener who invariably ends the season with a surplus of packaged seeds and hesitates to use them the following year lest it spell crop failure. Other claims for these hormone-like substances are: acceleration of seed germination, increase of crop yield, inhibiting of fungi growth, particularly of the damping-off variety, increase of


Science Service photograph
Simpler than soaking: painting slit twig-tip with colchicine

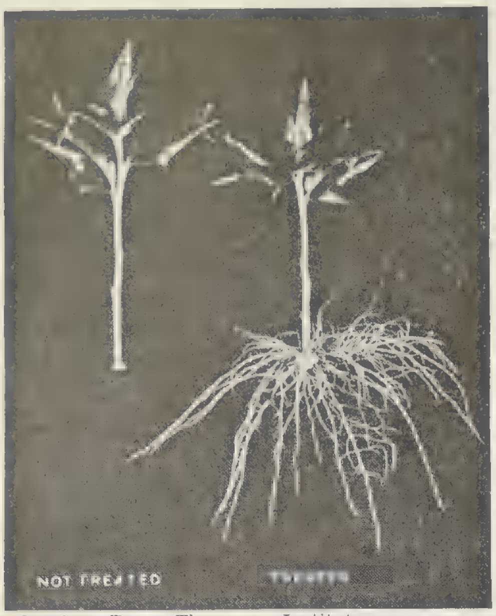
callus formation in grafting, the speeding up of bulb development, and the building of better lawn turf. However, no use of chemicals has reached the "simply add hot water and serve" stage, and until the amateur can maintain a cheerful attitude in the face of failure, he would do well to await more conclusive proof of these last mentioned wonders.

Seed catalog fans have been given a genuine thrill this year by the announcement of a chemically-produced variety of marigold. This is the first commercial offering arriving from the use of the powerful drug colchicine.

THE discovery that colchicine can retard cell division and multiply the number of chromosomes in a plant has occasioned wide speculation. Are we about to see the family-sized vegetable? Is the genius of the laboratory about to produce a Frankenstein monster? Well, there are limits to what colchicine will do. If breeding experiments begin with a squash, they end with one, although the new squash may be bigger and have qualities assembled to the breeder's taste.

Colchicine does put a very valuable tool in the hands of hybridizers and the result will most certainly be a quickening of new variety origination. What the drug really does is accelerate the natural process of breeding, to accomplish in comparatively short time what nature might take generations to do if, and when, she got around to it.

A stumbling block to breeding has been the difficulty in producing hybrids that are fertile, hence capable of reproduction. Sterility



Courtesy Boyce Thompson Institute

Hard-to-root holly. An example of chemically induced roots

is the rule; fertility the exception or the happy accident. These accidents are produced in nature without regard for time, and man's only improvement over the natural process has been to multiply the chances of an accident by mass planting and crossing. Colchicine, while not infallible, increases the number of chromosomes in many plants—doubling, tripling, quadrupling, dropping one chromosome off or adding one—to produce fertile hybrids. Thus the progeny, in turn, become capable of breeding, and the work of crossing, re-crossing, and back-crossing can proceed apace until the desired qualities have been assembled within a single plant.

It is conceivable that hybridizers may be able to use chemicals on annuals and give them a perennial quality. This would eliminate yearly planting. It might be that perennials could be endowed with qualities found only in annuals. There can be breeding to give plants resistance to diseases. This last has been accomplished already by older methods of trial and error, but now it can be done with more speed and certainty. Perhaps colchicine will produce results which never could come about by the happy accident system. If this proves to be true, the potentialities of the drug treatment can hardly be estimated at this stage of development.

The most recent chemical to be put before the public is Vitamin B-sub-one. Extraordinary claims are made for it, but very few can be substantiated. Certain species, notably camellias, orchids, and gardenias, are said to profit greatly by its use, probably because the plants cannot themselves produce enough of the vitamin for proper growth. All plants must have the vitamin, but most plants manufacture it and most soils have it in sufficient quantity. If the humus content of a garden is adequately maintained, use of the vitamin is superfluous.

If one tracks down to its source a tale of great success with Vitamin B-sub-one, it will be found very generally that the user has neglected to establish controls. Unless untreated stock is planted side by side with treated stock, no valid conclusions can be drawn. "Bigger and better" must always be qualified by reference to some controlled standard.

All this work with chemicals has great significance. It is widening our knowledge of plant life and opening new vistas for scientific exploration. Scientists and hybridizers will carry the work forward, but even the layman, if blessed with bright green thumbs, can make a contribution. There are a host of variables and unknowns left to be worked upon in the field and every successful field operation can be a contribution.

But don't forget. Plant chemicals are not labor-saving devices, nor are they panaceas for horticultural ills. If their role is not fully appreciated, there can be bitter disillusionment. If applied commercially at this stage by those who are inexperienced, they afford a quicker way to dissipate a fortune than raising chickens. They are, on the other hand, excellent tools for better and more intelligent plant cultivation, and their use offers the amateur an A1 hobby.

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EFFICIENT TURBINES

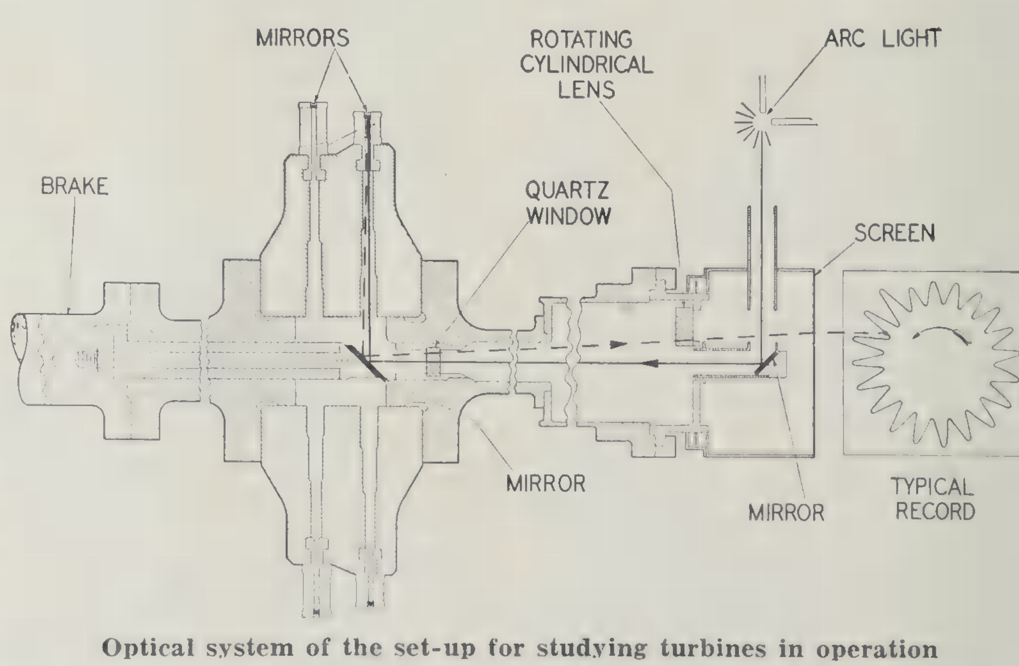
Cheaper Electricity Should Come From New Installation

MORE efficient and safer steam turbines, meaning cheaper electricity for everyone, should come from the new, full-sized but completely experimental turbine installation displayed recently at the Schuylkill Generating Station of the Philadelphia Electric Company.

The man behind this research, expected to furnish the bedrock of experience for tomorrow's sources of power, is F. T. Hague, engineer of the Westinghouse Electric and Manufacturing Company. In his laboratory studies he had pushed turbine steam operating characteristics up to 1250 pounds pressure and temperatures of 900 degrees—hot enough to melt lead. What he needed for a final test was a life-sized installation and a plant boiler capacity which could create the 125 tons of steam needed, each hour, to run such an installation. The plant of the Philadelphia Electric Company provided such capacity.

Moreover, this installation had to have some means of looking inside it and seeing how the turbine blades were vibrating under the extreme shock. "To form a mental picture of this shock," Mr. Hague explains, "imagine a turbine blade moving 350 miles an hour abruptly entering a steam jet density moving 1200 miles an hour." Oscillations at the rate of 126,000 times a minute occur in the blades, or 181,440,000 per 24-hour day.

Just as trees sway in a gale, so, too, do the turbine blades sway and



Optical system of the set-up for studying turbines in operation

vibrate under this super-hurricane of hot, "live" steam. If the vibrations are just right the blades enter into what engineers call resonance. Eventually they break off as their sway becomes greater and greater.

While the turbine blades are whirling some 60 revolutions a second around the turbine shaft, an automatic camera takes pictures through a tiny quartz window in the shaft at the rate of two a second.

"With this new apparatus," Mr. Hague explains, "a beam of light is carried through the shaft of the turbine and up into the blade itself, where mirrors reflect it out again, faithfully recording all vibrations. In this manner the harmonic movement of the blade can be recorded on film for any stated condition of operation.

"The light beam, supplied by an arc lamp, is deflected by a stationary mirror into the rotating shaft," he pointed out. "A slanted mirror inside the shaft throws the light beam through a hole in the rotor disk and then through a smaller hole inside the blade, towards a small curved mirror on the end of the blade. This curved mirror sends back the light by way of the slanted mirror in the shaft, to a screen.

"When the turbine rotates without vibration, the light point on the screen describes a circular path. But when the blade vibrates, the curved mirror mounted on the end of the blade deflects the light beam away from this path and waves or notches appear on the circle. The wavy circle described by the light is recorded on film by a specially designed speed camera.

"By study of the resulting pictures the stresses on the blades are deduced directly from the magnitude of the waves by proper calibration. By shifting the mirrors, it is possible to measure side-to-side as well as back-and-forth vibrations."—*Science Service.*

STAR "JACKETS"

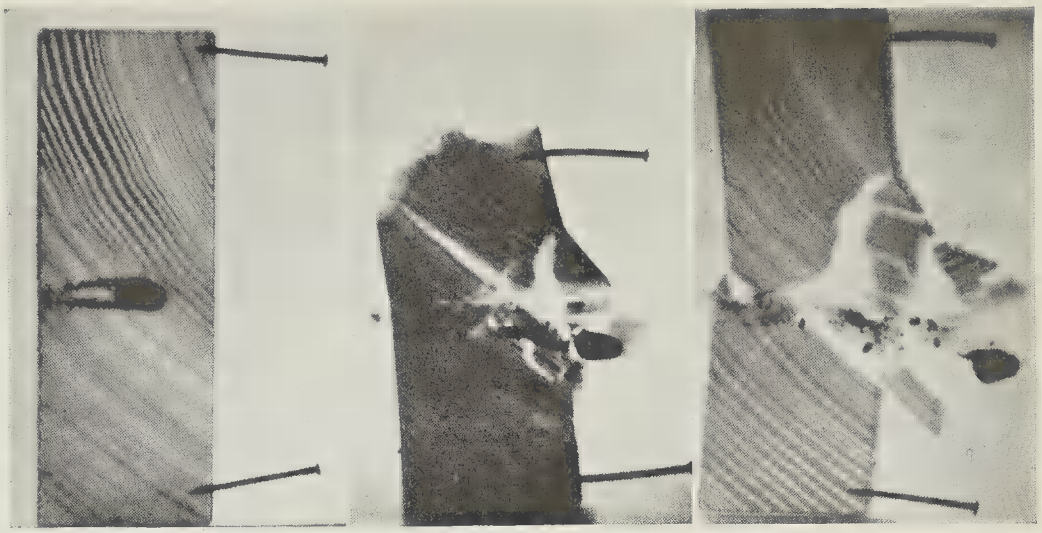
Iron Shells May Yield New Information

FROM iron "jackets" which encase certain stars and give out peculiar kinds of ultra-violet light, incapable of reproduction in laboratories, physicists hope to learn more about the atomic structure of important earthly metals.

Reporting in the *Astrophysical Journal* on researches he has made at the McDonald Observatory of the Universities of Chicago and Texas, Dr. Otto Struve, director of the Observatory and also of the University of Chicago's Yerkes Observatory, declares:

"The importance of this work consists in the fact that it provides information about some of the most common and useful substances, including chromium and titanium as well as iron. Such information can be found only in the stars."

The metallic jackets around these stars are in gaseous form, at temperatures far higher than the boiling point of iron. Subjected to this intense heat, the atoms give off radiations which cannot be produced on earth, partly because there is not enough gaseous iron on the earth, and also because such high temperatures cannot be reached. For this reason, physicists refer to these radiations as "forbidden." — *Science Service.*



Three X-ray snapshots of bullets piercing blocks of wood. In center photo, note trail of lead; in right photo, bullet literally explodes wood

X-RAY SNAPSHOTS

Millionth of a Second With New Ultra-High Speed X-Ray

A RIFLE is fired in the research laboratory, and a bullet tears through a block of wood placed between an odd looking glass tube and a flat aluminum box. A football player boots the pigskin from its strange perch atop the same box. A golfer drives a ball from a makeshift paper tee on the box.

And in one millionth of a second —less than one twenty-thousandth of the time required to blink an eye —the glass tube produces and releases a heavy surge of penetrating X-rays. A few minutes later, on an X-ray film taken from the aluminum box and developed, Westinghouse research engineers can learn exactly what has happened during the millionth part of a second as the bullet plowed through the wood, the football player kicked the ball, or the golfer made his drive.

Development of a new ultra-high speed X-ray tube which enables engineers to make these fast X-ray "stills" was announced recently by Dr. Charles M. Slack, research physicist for the Westinghouse Lamp Division.

Westinghouse engineers believe development of the tube may presage a day when many desirable and hitherto impossible tasks may be accomplished. Machine and motor builders, for example, will be able to study internal strains in rapidly moving parts. Makers of sporting rifles, shotguns, and ammunition may determine any slight deflection of a bullet in its passage through a gun barrel, or observe the distribution of shot at various points in its flight from shotgun shell to muzzle. It is even held possible that X-ray motion pictures may be made of such parts and objects, and many others.

ATOMIC POWER

Released Spontaneously By Uranium

ATOMIC power is released from uranium spontaneously without atom-smashing bombardment with neutrons, two Leningrad physicists report in the *Physical Review,* American Physical Society journal. But the observations of the two Soviet scientists, Flerov and Petrjak, hold out no hope that there will be any practical utilization of this energy from the splitting of the uranium atom. Only six fissions an hour were discovered.—*Science Service.*

Physics In Court

Computations by Which Police Can Work Out Driving Speeds from Skid Marks after Accidents

C. W. SHEPPARD

Although the determination of the minimum speed of automobiles by the length of their skid marks has been known in courts of law for a good many years, it was not until quite recently that it was put on a systematic basis. Since 1938 such cities as Evanston, Illinois, and Pasadena, Calfornia, have been keeping a systematic record of all skid marks left on the street after traffic accidents, and in the later city, due to the unceasing efforts of Police Physicist William W. Harper, such evidence has become of increasing value in convicting law violators.

Let us consider a typical case which recently came before a western court. A man and his wife were crossing the street. It was after dark, and in a section of the city which is not too well lighted. A driver ran into them, inflicting severe injuries. Measurements showed that the car skidded 65 feet after the driver applied the brakes. From simple calculations based on this evidence, his speed was shown to have been at least 40 miles per hour and, even in the absence of eye witnesses, he was convicted of exceeding the speed limit, on a basis of the skid alone.

The computations involved in such a case are simple. Those who can recall their elementary physics will know that the distance d, which a body of velocity v will travel under a deceleration, a, is given by the formula $v^2=2\,ad$. This formula can be changed slightly to be more useful. If v is given in miles per hour, d in feet, and a is expressed as K (its percentage of the acceleration of gravity) the equation becomes $v^2=30\,Kd$. To illustrate, let us suppose that a car has a braking power, K, of 70 percent. This means, that, during a stop, it will have a force on it equal to 70 percent of its weight, which will slow it down at the rate of 22.4 feet per second every second. This would be approximately the conditions encountered on dry pavement with ordinary tires.

The value of K is known for a good many types of tires and road surfaces, but, unless it is impossible to do so, calculations are based upon test skids made with the car itself. This method makes use of the fact, as seen from the formula, that the length of a skid increases as the square of the speed of the car. One must remember that, once the car begins to skid, the length of the skid becomes a matter of tire and road surface, independent of the effect of the brakes. Any wheel which is not skidding will be so close to skidding as to be under substantially identical forces. The procedure is as follows: Assuming that the car is not severely damaged after the accident, three trial skids are made at a speed of 20 miles per hour and under carefully controlled conditions. From the known law of skid distance, the minimum speed of the car before the accident may be found by simple arithmetic or by the use of a chart devised by Mr. Harper.

These charts, on especially prepared cross-section paper, permit speed in miles per hour to be arrived at quickly, and include allowances for varying co-officients of friction. They also serve as a permanent record of the several factors entering into the skid-speed test of the car.

Making skid tests requires that the car should not have been badly damaged. Nevertheless, in the case of severe damage it is still frequently possible to estimate the speed of the car by the quite accurate information now available as to the friction of tires on various kinds of pavement. Estimates of this type can be made by an experienced man and, though not quite as accurate as in the case of skid tests, they nevertheless often show conclusively that the car in question was exceeding the speed limit. In one recent case a car left skid marks 145 feet long and was demolished in a collision in which five people were killed. When a K of 70 percent was assumed, a minimum speed of 55 miles per hour was given. To this was added the conservative figure of ten miles per hour for the velocity absorbed in the collision damage, showing that the original speed was clearly greater than 65 miles per hour.

As one might expect, courts have been slow to accept skid-mark evidence as conclusive. Judges have sometimes consented to witness tests of the reliability of the method. One such test was made in Pasadena. In Mr. Harper's absence a skid was made at 33 miles per hour. He then was permitted to

Skid marks 60 feet long, left by a car at the scene of an accident. Marker boards are shown laid on the pavement at ten-foot intervals by the police

From a movie taken at Edison anniversary dinner, December 20, 1909. Mr. Edison left of center; Mr. Smith (see article below) second from left

measure the marks and calculate the minimum speed. With little apparent difficulty he quickly determined the speed as being greater than 31 miles per hour.

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EDISON

One of His Co-Workers Supplies An Anecdote

RECENT interest in the activities of that Grand Old Man of Inventors, Thomas A. Edison, engendered by two motion pictures built around his life, gives added value to the photograph reproduced on this page. This picture, taken from a Mutoscope movie made in 1909, is claimed to be the first motion picture for which Mr. Edison ever posed.

For the reproduction of this illustration we are indebted to Mr. Albert E. Smith, now of Hollywood, California, and formerly associated closely with Mr. Edison. The occasion on which this movie was made was one of Mr. Edison's anniversary dinners, given on Monday evening, December 20, 1909.

"Every year the moving picture producers of that day," writes Mr. Smith in a letter to the editor, "gave Mr. Edison an anniversary dinner at the Plaza Hotel. On this particular occasion, before we went to the Plaza, we went to the old Vitagraph studios in East 14th Street and D. W. Griffith took the picture.

"I was very well acquainted with 'the Old Man,' " continues Mr. Smith. "He was called this affectionately by all who knew him. Usually at these dinners I would sit on Edison's right, not as a seat of honor, I think, but because my voice was high pitched and penetrating and the right was his better ear.

"Of the many stories told me by Mr. Edison is one that I think will bear re-telling. It regards the sale of his first patented invention—the duplex telegraph system. A group of men in New York had offered to buy the invention. Mr. Edison talked it over with his wife and they agreed that he should ask \$3000; if the buyers would not pay that amount he would come down to \$2000 but that was to be the lowest.

"Mr. Edison met the group in New York and after some small talk they asked him if he had arrived at a price. Mr. Edison told me that he was so nervous that he stammered and could not get the figure out. A dictatorial man among the group of would-be purchasers of the system broke in with: 'Now, it's no use asking us a big price, Mr. Edison. We have made up our minds what we will pay and we won't pay a cent more. In fact, I may as well tell you that \$40,000 is our limit.' Edison told me that he nearly fainted but rallied enough to assent.

"The contract was drawn up," continues Mr. Smith, "and Edison stipulated that he was to be paid in cash, in \$5 bills. One of the men tried to talk him into taking a check but Edison did not trust banks and very plainly said so. On the day of settlement he went to New York, signed the papers, and was paid the money. With the bills stuffed in the pockets of his suit and overcoat, Mr. Edison started home, fearing that every man who looked at him knew that his pockets were full of bills.

"When Mr. Edison arrived home he was in such a funk that he sat up all night near the kitchen stove with a double-barrelled shotgun across his lap. By morning he was nearly exhausted and decided to take the advice that had been given. So he went back to New York and found the man who had previously suggested placing the money in a bank. On Mr. Edison's request, this gentleman took him to a bank and helped him to open an account.

"Edison, in telling me of this experience," concludes Mr. Smith, "said that he then went home and within a month had spent all the money. I was astonished and asked him how he had spent it. His reply was, 'On machinery. I had never before had a machine shop. Then I had a good one.' "

INVENTORS AID

Physics Course Gives Background Knowledge

INVENTORS and others who lack formal training in the fundamentals of physics, or who wish to review the subject, will be interested in a special course to be conducted this fall and early winter. Held at New York University, under the direction of Joseph H. Kraus, the course will include rudimentary principles of physics and their practical applications in a wide variety of industrial fields.

At each session of the course there will be an open forum for discussion of new inventions, proposed developments, and so on.

FLUXES

Aids to Welding And Soldering

THE paradox of welding aluminum at a temperature below the melting point of the metal is achieved by the use of a welding flux developed by the Alwarth Chemical Corporation. The new flux is used to coat the ordinary welding rod which contains approximately 5 percent silicon. The weld may then be made

without sweating the parent metal; hence, the area adjacent to the weld retains its full strength and ductility.

Another flux for use on stainless steel, and made by the same company, is said to eliminate the unpleasant fumes ordinarily present in stainless steel soldering.

Still another flux may be used on rusty iron, dirty brass or copper, or, in fact, any metal except aluminum. By its use, retinning of rusted surfaces can be done with a minimum of labor.

AVALANCHES BOMBED

Explosives Break Loose Snow and Ice

WHILE much of Europe has felt the destructive power of bombs in recent months, at least one country has been using these deadly missiles for a beneficial use. Switzerland is

Starting an avalanche

using them to shoot down avalanches under control.

Each year in the Swiss Alps there are many victims of natural avalanches. Mountain climbers are often caught in them, and there is a sad record from the first World War indicating that on a single day in December, 1916, over 10,000 soldiers stationed in the Tyrol mountains of old Austria fell prey to avalanches.

In the Alps, the blanket of snow is now regarded almost as a live thing that can become a deadly menace to humans. Hence the Swiss have established a Snow Avalanche Research Station above Davos — the only one of its kind in the world. This station can foretell avalanches and issue necessary warnings. Furthermore, if the avalanche location can be reached, hand grenades are used to start it moving. If big avalanches are involved, their descent is started by trench mortars.

This work is being carried on constantly to safeguard the lives of skiers, of travelers over alpine roads, and of soldiers stationed in the mountains. The new method eliminates the great danger of the large spring avalanches which formerly, uncontrolled, often destroyed homes, bridges, highways, and roads.

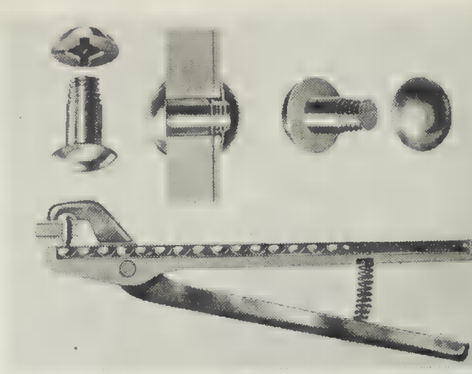
SNAP RIVET

"Bachelor's Button" Fastener For Metals

A NEW spring locking button and fastener stud provides a rivet-type fastener for many uses. This button will substitute for the present speed nuts and screws and other types of nuts, and in exposed places it will have a finished appearance. It is so designed that it will not loosen from vibration. It is an invention of David Hoppenstand and is produced by the Hopkan Rivet Company.

The fastener stud has a head and a shank like the average rivet, but the shank is tapered toward the end and provided with a number of parallel ring grooves. The spring locking button is made of thin sheet steel with locking lugs extending inwardly from the opposite edges of the curved shell. These locking lugs grip the rings on the shank of the stud.

Because of its simplicity and the ease with which it may be installed, this new fastening unit may be used in the automotive, aircraft, and refrigeration fields. It can be made



Snap rivets and applicator tool

from any type of alloy, and the spring locking button can be made in any shape — circular, flat, diagonal — and in any size.

HAM TELEVISION

New Transmitting Tube Now Available to Amateurs

INEXPENSIVE, a television camera "eye" tube which opens the field of electronic television to thousands of American radio amateurs, is a much simplified version of the more familiar "iconoscope" television camera tubes used in studio cameras. It is being placed on the market to sell at slightly less than $25.

With the new iconoscope, it is practicable for the first time for the amateur to build a complete electronic television transmitting and receiving system at a total cost of approximately $300 or less, depending on the equipment which he has at hand. Amateurs who now have 2½-meter transmitters will find it relatively simple to adapt them for sending television signals alternately with sound broadcasts.

The 120-line pictures transmitted by the amateurs' iconoscope,

Radio ham televises his call letters with new transmitter tube

while not of the same excellent quality as the 441-line television images being broadcast in New York, are remarkably clear and sharp, equivalent to newspaper half-tone reproduction. The new iconoscope transmits a television picture about 1½ inches square which may be enlarged at the receiver.

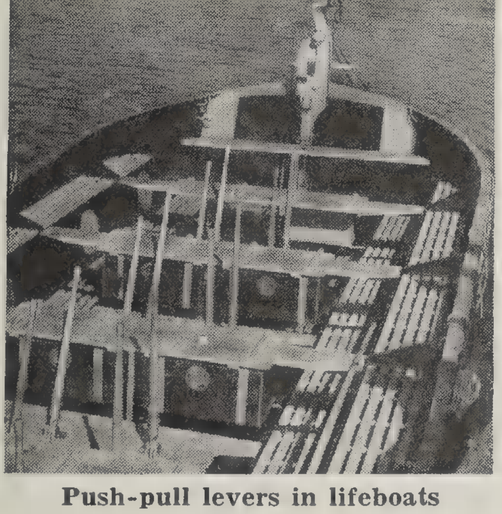
In research and development work on this new unit, RCA Laboratories collaborated with the American Radio Relay League, which has been seeking for several years to make it possible for the amateur radio enthusiasts to enter the television field. All the necessary equipment has been available for some time for amateurs, with the exception of the iconoscope. Television receiving tubes, or kinescopes, have been available in sizes as small as three inches.

It is believed that the opening of the electronic television field to amateurs will serve to widen existing popular interest in the new art, and at the same time accelerate progress in television development. The radio industry today points to a number of important steps pioneered by American amateurs, including the development of new circuits. Radio amateurs were among the first to demonstrate the enormous possibilities of short waves, a region which at the time was not highly regarded for radio purposes.

LIFEBOAT

Oarless, Motorless Boat Has Screw Propeller

READY for service in troublous times, the U. S. liner *America* is prepared for any emergency. Fourteen of her lifeboats, for example, use a manually-operated system of push-pull levers instead of oars or



Push-pull levers in lifeboats

Levers operate a propeller

motor. This method gives passengers something to do, eliminates confusion caused by inexperienced oarsmen.

The propeller to which the levers are geared had to be designed within definite size and weight limitations. The Federal-Mogul Corporation solved the problem in an unusual manner. They adapted their original "Equi-Poise" design, created for the propellers of Gar Wood's famous speedboat *Miss America X*, to the new lifeboats. They then cast the wheels from Lynite, an alloy developed by the Aluminum Company of America, which cuts the propeller weight to one third normal, and has high resistance to salt water corrosion.

Any number of crew or passengers from one to sixteen can operate the simple push-pull levers —and they don't have to work in unison—to move the boat. It has a maximum speed of six miles per hour.

The idea behind these novel lifeboats is that they will provide sufficient speed quickly to carry a large number of people away from immediate danger, and thereafter they can be towed by the *America's* power-driven lifeboats.

WOOD SEASONING

Urea Prevents Drying Losses

CRYSTAL urea is now being used as a chemical seasoning agent to prevent checking, splitting, and such losses as occur in drying lumber in the air or in the kiln. Fresh-cut lumber dries first at the surface, but when treated with a solution of urea, the outer surface remains moist and drying proceeds from within, thus eliminating the stresses that cause trouble.

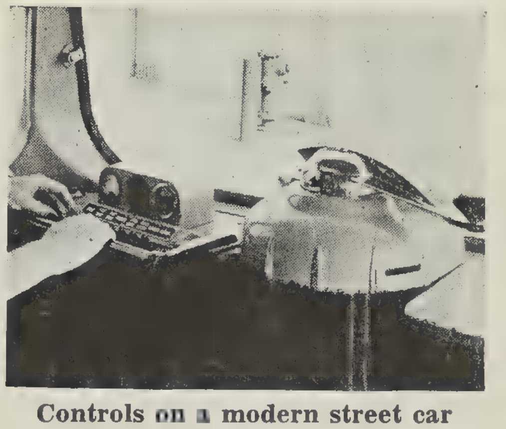
This treatment is easy to apply, permits faster and more severe kiln schedules, thus increasing the plant output. Urea, non-toxic, stable and harmless to the skin, is not corrosive to metals used with wood or to tools or knives employed in dressing lumber. Urea-treated wood is also less flammable and less susceptible to attack by fungi and rot than untreated wood.

Mill-scale treatments on Douglas fir and hemlock in the Northwest and on red cypress in the South are now being made. Tests are in progress on other woods.—*The duPont Magazine.*

STREET CARS

Modernized for Modern Service

ALTHOUGH people generally have the idea that street cars are on the way out, these vehicles continue to be improved so that they render in-



Controls on a modern street car

dispensable service in certain localities. San Francisco, for example, has just put into service a number of streamlined street cars which operate and stop without a jar or jolt, ride smoothly even at rail intersections, and, in fact, give service that is modern in all respects. Our photograph shows the manner in which the motorman's cockpit has been modernized, following in general the design of automobile dashboards.

JAP BEETLES

Yellow Traps Found Most Effective

THE bright yellow color of the Japanese beetle traps set in 1940 by the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture is the result of research developments in tests last season. Most beetle traps had been green, or green and white. The "scouting" traps widely distributed by the Federal entomologists were uniform, but traps on the open market were available in many shades of green, and the

beetle research organization decided to investigate differences in attractiveness, to the beetles, of the various shades of green, as well as of other colors. This investigation showed that traps painted yellow caught approximately 50 percent more beetles than the standard green and white traps. Yellow pigment added to any other color of paint increased the numbers of beetles captured.

PLANT TAGS

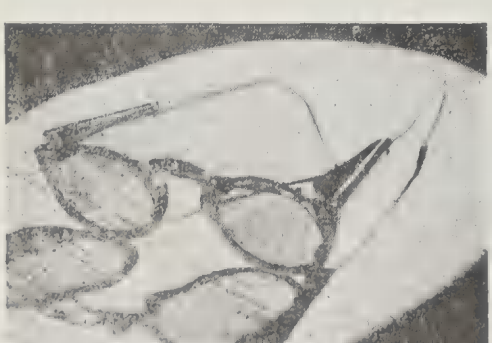
Metal Labels Provide Permanent Identification

A special alloy of metal, flexible and resistant to acids and ground chemicals, has solved one of the most annoying problems of gardeners. Professor Aden J. King, who is a gardener as well as a college professor of chemistry, has used this metal to make a plant label. Since it is similar to a very heavy foil, a soft pencil is all that is necessary to print the name of plants or shrubs on this new Perm-A-Tag. The printing makes a permanent impression in the metal. The user may, if he so desires, mount the strips in his typewriter and type the names thereon. After that a tongue and slot arrangement makes it easy to loop the label around a plant or shrub and clamp it firmly without the use of any tools.

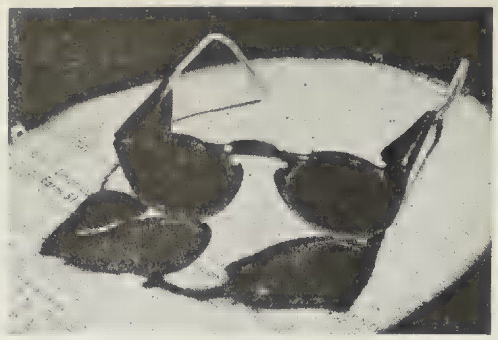
EYE PROTECTION

Variable Sun Glasses Give User Control of Brightness

The conventional sun glasses with tinted lenses offer only one degree of brightness control for the wearer. Polaroid sun glasses sold in previous years, while they provided better protection for the eyes against the glare of sun, still offered one degree of brightness control. However, the Polaroid Corporation has now developed a Polaroid



Set for maximum transmission



Set for minimum transmission

Variable Day Glass which permits the wearer to control the brightness of the view.

Instead of only one lens before each eye, the new Polaroid Variable Day Glass has two lenses. The front lens before each eye is stationary in the frame while the two rear lenses may be rotated by a convenient button on the bridge of the frame. Simple movement of this button with the finger rotates the rear lenses so that more or less light may pass through, according to the angles between the polarizing material in the front and rear lenses. Thus the wearer may cut down light transmission on a very brilliant day or allow more light to pass through on a duller day. Adjustment of the lenses may always be such as to provide the greatest comfort and efficient vision for the user, regardless of his particular tolerance for excessive brightness.

POST DRIVING

Small Explosive Charge Drives Piling or Posts

Often it is essential to put a pile or post in water or wet ground where a pile driver is not available, or when so few piles are to be driven as not to warrant bringing in a heavy piece of equipment.

A method has been worked out whereby the force of dynamite can be used to transmit a blow which is somewhat similar to the dropping of a pile driver hammer. The pile is stood upright in the location desired, and braced in place—usually with rope. The head of the pile should be sawed off square and the procedure is to put a heavy plate of steel on top of the pile. To give the best results, the plate should be one inch to 1½ inches thick. One stick of dynamite is placed on top of the plate, and covered with mud after the stick has been properly primed with a blasting cap and fuse or an electric blasting cap. When the charge is exploded, the force is transmitted to the plate which in turn transmits it to the pile. The pile is driven into the ground sometimes as much as 14 inches if the ground is soft. The procedure is then repeated until one inch penetration per explosion is obtained.—*Agricultural News Letter* (du Pont).

FLASHLIGHT

Rod-like Gadget Extends Any Flashlight

For use in inaccessible places, a flashlight bulb extension has been developed. Made in lengths of from six to 36 inches, the extension's

To get light where needed

plug is screwed into any flashlight; a bulb is in the socket on the other end. Being bendable, the extension can be inserted into intricate mechanisms, or into bores on a lathe. It aids vision down between walls, back behind fittings, inside of models, down among gears—in fact, any place where there is at least one-half inch clearance for the bulb end.

Known as the Sierra Flashlight Bulb Extension, the device is made of special wire encased in aluminum alloy tubing.

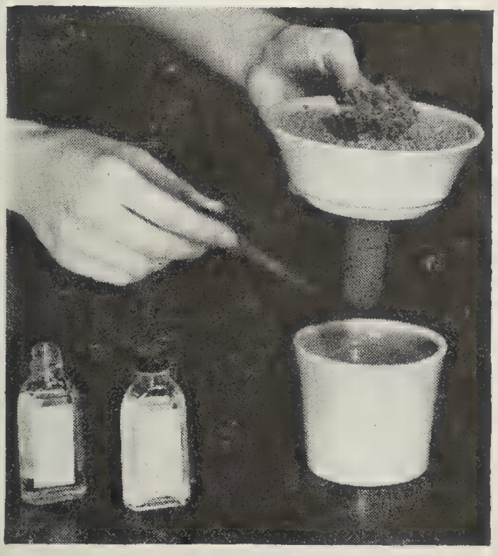
CHEMICAL GARDEN POTS

Home Plants May Now Be Grown in Chemicals

Home experimenters in chemical gardening who have been handicapped by lack of suitable and attractive containers may now thank Ernest W. Brundin for making chemical gardening pots and gardens available. This large commer-

cial grower of tomatoes in nutrient solution and founder of Chemical Gardens, Inc., has designed glazed, two-compartment, pottery containers in a variety of shapes and colors. Either seeds, seedlings, or mature plants may be grown in these.

Mr. Brundin's containers are made in two parts, the upper one



For feeding plants chemically

fitting into the lower one and making a complete unit of attractive design. The lower one holds the chemical solution in water. The upper is filled with clean, sharp sand. A terra cotta wick extends through a hole in the bottom of the upper section down into the water. Capillary attraction supplies plenty of water and food to the sand bed above.

Two small bottles of plant food concentrates are supplied with the chemical gardens, and last for many months. A quantity of each solution is measured into a given quantity of water about once every 15 days, and the mixture poured into the bottom section. The chemical balance of the prepared liquids is such that changes made by the plant in the silica bed are constantly corrected automatically by the supply coming up through the wick.

INSECT-REPELLENTS

There is no Plant Which Repels all Insects

THE idea that certain plants in the garden will drive away mosquitoes and all other insect pests is attractive, but unfortunately, says F. C. Bishopp of the United States Department of Agriculture, it does not seem to work out in practice. No such plant is known. If any plant were a good repellent, it would probably be because it con-

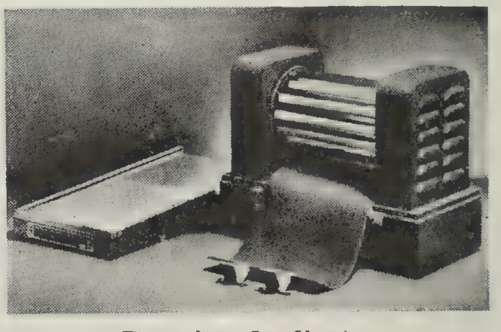
tained some chemical substance offensive to all insects. Scientists have sought such a chemical but never have found one.

There are chemicals effective against certain insects, but differences in sense of smell among insects appear to be as great as among the higher animals, says Bishopp, who studies insects that affect man and animals. Don't put too much faith in chemical repellents or any other single type of protection against all insect pests, he advises.

DUPLICATORS

New Method for Making Employs Photochemical Stencils

A NEW method of making duplicate copies of line drawings in quantity has recently been developed by A. B. Dick Company, makers of the Mimeograph duplicator. The new Mimeograph photochemical printer



Drawing duplicator

makes possible quick, accurate transference of any opaque drawing to a stencil sheet for black-and-white reproduction.

The chief element of the printer is a new cool, brilliant light source, unvarying in intensity, with remarkably low consumption of electricity and dependably constant results. Around the evenly distributed light-tubing is a heavy, unbreakable transparent cylinder, free of blemishes that might affect the exposure of the stencil sheet.

To make the photochemical stencil, it is first made light-sensitive with sensitizing solution. Next, the original tracing and the stencil sheet are exposed to light in the printer. By this exposure the image on the tracing is transferred to the sensitized stencil sheet in a single step. The stencil is then developed on the developing plate and placed on the Mimeograph duplicator for black-and-white reproduction of dozens or hundreds of copies, as desired.

The time of the procedure, from finished drawing to finished copies, is generally less than 25 minutes.

Price of materials for producing the stencil—including the stencil sheet—is less than 25 cents.

Any size drawing up to 7¼ by 14 inches, on paper not larger than 8½ by 16 inches, may be used as an original. The only requirement is that the image on the original be thoroughly opaque and the exact size desired in the finished copies. India ink tracings on translucent cloth or paper are recommended for best results. Typewritten matter cannot be reproduced on the photochemical stencil.

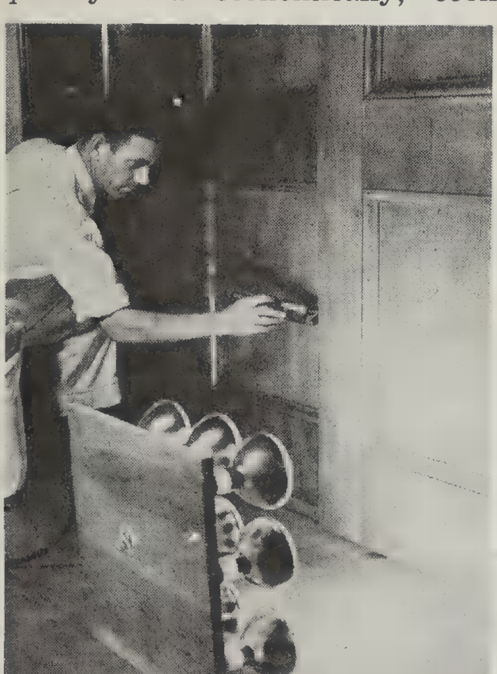
The photochemical printer is portable and may be used in mechanical arts and music departments of schools, engineer's offices, and factories. A few suggested applications are quantity duplication of tracings for engineering, production, and sales engineering departments; erection and installation diagrams; graphic instructions of all kinds; technical illustrations for parts and instructional catalogs.

The printer requires alternating current, 60-cycle, 110 volts.

PAINT DRYER

Infra-Red Lamps Given New Job

More and more are infra-red rays being utilized for finish-drying purposes. These heat rays in suitable reflectors have been utilized for several years to dry very rapidly the lacquers on, for example, automobile bodies. Now small infra-red lamps have been given the job of drying many things around the home. At the flick of a switch the housewife may soon turn on lamps to dry the family washing quickly and economically, cook



Infra-red dries paint quickly

food, or heat a room or an entire house in cold weather.

Our accompanying illustration, used through the courtesy of Westinghouse, shows a particularly important use of such lamps for drying interior paints. In such use, household annoyance due to repainting is greatly reduced, or an apartment is made ready more quickly for incoming tenants. Furthermore, the paint is dried so quickly that there is little chance for dust settling on the surface.

NAVIGATION TABLES

New Method Decreases Computation, Simplifies Study

A SIMPLIFIED method of determining the position of a ship or an airplane, eliminating nearly all the involved mathematical computation of older procedures, is now available for ocean commerce and modern, high speed, air transportation.

This new method is based on the use of navigation tables which are being computed and assembled by the Work Projects Adminstration in co-operation with the Hydrographic Office of the United States Navy. WPA workers, under the supervision of the Hydrographic office, have assembled the tables in volumes covering 10 degrees of latitude, usable in both the southern and northern hemispheres. Four volumes of this work are available to navigators, while a fifth will be available this year.

Under ordinary conditions, a training period of at least eight months is necessary to develop facility in navigation. With the new tables, it is estimated that the training period can be reduced to about six weeks. By using this new aid—called "H. O. 214—Tables of Computed Altitude and Azimuth"—a navigator either at sea or in the air can find immediately the altitude angle and azimuth, or bearing, which correspond to his assumed latitude and longitude without having to compute it.

All U. S. Government services, including the U. S. Navy, Coast Guard, Army Air Corps, and the Coast and Geodetic Survey, are now using these tables in their navigation and scientific work while an increasing number of private seamen, yachtsmen, and aviators of all nations are finding the easier method valuable.

DRAFTING CAMERA

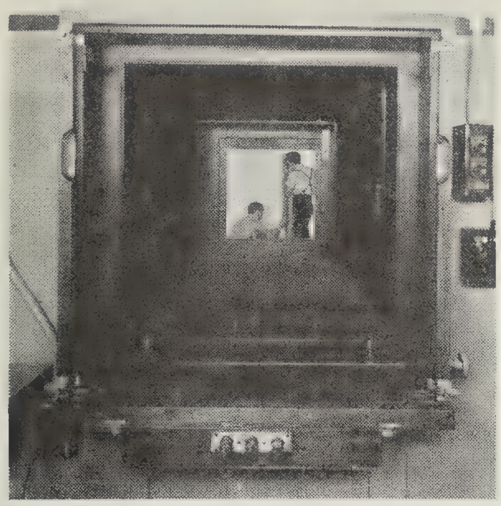
Huge Machine Copies Large Drawings Quickly

AN important new process by which engineering drawings are directly reproduced, photographically, on nearly any kind of surface (metal, wood, cloth, and paper, to mention a few) has been announced by The Glenn L. Martin Company. This new process is credited with much responsibility for the factory's mass-production methods in building airplanes, and is expected to have wide application in many other industries.

An heroic-scale camera snaps pictures of large drawings, the negatives are developed, and the images projected back to large sheets of aluminum alloy sensitized with a special emulsion. When such a sheet (maximum standard size used is 10 by 5 feet, but it could be larger) is placed in huge developing tanks, the drawing appears in all its preciseness on the surface in exact scale—or in fractional or multiple scales, if so desired.

Thus there can be produced in

Laying out airplane parts drawings, later to be photographed



Looking through the giant camera with which photo prints are made on metal, wood, and so on

a matter of minutes any number of drawings which might have required days in redrafting. The company saved more than $80,000 last year in drafting alone. Engineering work is speeded tremendously. Tool designing and tool making gets under way more rapidly and more accurately. Production preparation starts quicker and changes are made more rapidly. And because there are plenty of the exact-scale drawings available, the whole effort of the several vital departments is co-ordinated, all of which adds up to incomputable savings.

The versatile process has many other uses in the plant. Where an experimental airplane is to be built, the master drawings, absolutely accurate in every detail, can be photographed directly onto the metal of which the ship is to be constructed and the parts cut directly from the material itself. If a wind-tunnel or water basin model of a projected airplane is desired, it is only necessary to call on the camera to scale down the lines instantly from full size to an eighth, or tenth, or any other fraction of the full size. An easy calibration of the camera turns the trick, saving perhaps weeks of redrawing to scale.

SOIL MOISTURE

Simple Test for Water in Farm Soil

A BLOCK of plaster of Paris the size of a match box, some wire, and a small electrical apparatus so simple to operate that no training is required, are all a farmer now needs to determine the amount of water in his soil. The new method of measuring moisture in the ground was developed by the soils section of Michigan State College. A continuous measurement of soil moisture changes can be made by the process without disturbing either the soil or the crop.

In this novel approach to agronomic and irrigation problems, a block of plaster with attached wires is buried in the ground and allowed to absorb water until an equilibrium between it and the soil is established. By using an ordinary piece of electrical equipment known as a Wheatstone bridge, a measurement is then taken of the amount of resistance to electricity offered by the block.

Since water contained in soil readily conducts electricity, the greater the amount of moisture present the wetter the plaster and the less the resistance. If the ground is dry, the block offers greater resistance. Many absorption blocks may be distributed over the growing area at various depths to provide a complete picture of water fluctuations and movements within the soil and to furnish numerous control points.

The lead wires can be buried below tillage depth. When a measurement is desired, the block is connected to the bridge and the resistance can be determined in from 20 to 30 seconds. The electrical apparatus, being portable, can be used with any number of absorption blocks.

When the resistance of the absorption block becomes constant at about 400 to 600 ohms, the soil in which it is imbedded is holding about the maximum amount of moisture desirable for the growth of most plants. On the other extreme, as the resistance of the block passes to 60,000 ohms, soil moisture is approaching a minimum level with regard to plant requirements. Few plants will thrive in this dry soil and most plants wilt if more moisture is lost.

RIVETS

Explosive Forms Heads Without Backing Up

IN constructing such machines as tanks and airplanes it is often necessary to rivet the shell at points where it is impossible for someone to back up the rivet in order to form a head. As long ago as 1937 the German Heinkel concern partially solved this problem by production of a hollow rivet containing an explosive. This rivet was to be inserted in the rivet hole

from the outside and, when heated, it exploded to form a shank inside to hold the plates together. However, the explosive corroded the opposite surface of the plate and the cost was high. Furthermore, Heinkel bombers shot down in England show that such explosive rivets are far from uniform and are used only in unstressed parts.

The DuPont company has improved upon the explosive rivets by developing an explosive powder which gives complete uniformity of explosive force and, therefore, uniformity of the rivet heads that are formed by that force. This powder is said to be non-corrosive and the cost works out at about three cents per rivet. Riveting is done with a simple electric or benzine heating gun, the time for each rivet being about 1½ seconds.

Besides facilitating construction, these rivets may also be used effectively in repair work. A hole made by a bullet or a shell fragment might be trimmed out of a plane wing, a patch fitted in place, and fastened tightly by means of these rivets.

"MAGIC" LANTERN

Visual Aid Throws Stereoscopic Pictures

FOR the first time in the history of the manufacture of visual aids for selling and teaching, an automatic projector for showing glass slides in three dimensions is now being made. It is the Real Life Projector of the Three Dimension Corporation. Slide pictures projected from this machine onto a screen and viewed through Polaroid spectacles give an appearance of true depth.

The machine is entirely automatic in its operation, feeding automatically all the slides in a tray holding 35. When that is empty, it may be instantly replaced with another fully loaded.

"Magic" lantern up-to-date

Business executives interested in showing the true contours of products, the true color of finishes, or the true texture of fabrics and surfaces, might use this device to advantage. In lectures of many kinds and in many fields of education it would prove a welcome aid to the speaker or teacher.

PLUG-IN X-RAY

Portable Machine Has High Capacity

PORTABLE and shock-proof yet having the 80,000-volt capacity of much larger standard machines, a new X-ray machine introduced by Profession Equipment Company promises to perform jobs hitherto impossible because of the bulk of older equipment. It was designed and assembled with the co-operation of C. E. Waltman and Associates.

Portable X-ray

The new machine is demountable and easily portable in two small carrying cases, the total weight being only 64 pounds. It plugs into a regular electrical outlet.

BATTERY TESTER

Pocket-size for Servicemen

A POCKET-SIZE battery tester to meet the need for a compact, inexpensive unit for correct testing of dry batteries under load, has just been announced. Made by Weston Electrical Instrument Corporation, the new unit will be of particular interest to radio servicemen whose tube checkers do not contain provision for this important new test requirement, or wherever else dry

batteries should be tested under load.

The pocket-size unit has been designed to fulfil the fundamental requirements for correct battery testing; that is, when the battery shows "good" on the instrument scale, it will be capable of delivering sufficient potential when under full load.

To test dry cells under load

In order to facilitate new battery sales and replacements, the scale consists simply of a "Replace — Good" indication, uncomplicated by voltage indications, which might be confusing to the layman. Pin jacks are provided for the different battery voltages encountered — 1.5, 4.5, 6, 7.5, 45, and 90 volts.

TRACING PAPER

Better Blue-Prints From Pencil Sketches

Draftsmen often have occasion to make relatively complete drawings on tracing paper in pencil. When blue-prints are made from these, however, the lines are usually very weak and never completely satisfactory. The Frederick Post Company has developed a new paper called PTM which not only gives greater depth and blackness to the pencil line but also is more transparent than ordinary tracing paper. The surface of this sheet is dull and has a sharp but very fine "tooth."

WAR GASOLINE

It is figured that one day's operation of a fleet of bombing and pursuit planes necessitates the consumption of an amount of motor fuel sufficient to operate 3000 American passenger cars for a full year!

Data show that 2400 bombers consume about 288,000 gallons per hour, 1600 pursuit planes consume 160,000 gallons per hour. Total daily consumption, on the basis of five hours in the air, exceeds two and one-quarter million gallons of fuel.

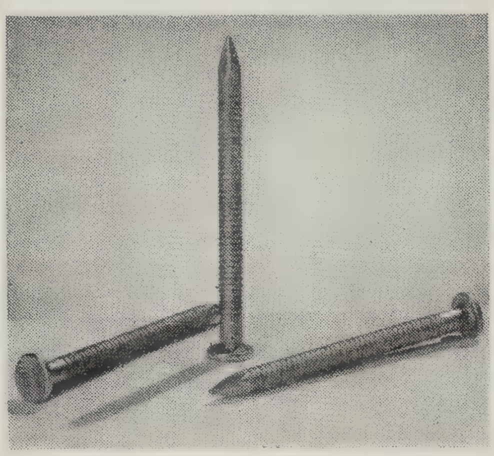
Consumption by tanks, trucks, armored cars, motorcycles, and other motorized equipment is believed to be even greater.—American Petroleum Institute.

RUST PROOF NAIL

Unique Design For Boats Out-Holds Screw

A new rust-proof nail of odd and unique design, developed for the boat-building industry, has revealed in a series of tests an unusual combination of properties which indicate its value for a wide range of industries where corrosion is encountered. In a special demonstration for naval architects it outheld a screw.

The nail is made of Monel and its holding power is derived from a series of sharp annular rings rolled-on in manufacturing operations. These rings are sharp and set at such an angle that in driving they won't disrupt the fibers of the wood. The nail can be driven quickly without drilling a pilot hole—even into oak—and it requires no clinching.



Annular rings, rolled-on, give nails unusual holding qualities

Another feature of this new nail is an exceptionally heavy head; in the case of a two-inch nail, the head is 5/16 of an inch in diameter and 1/16 of an inch thick. The heads are two gages heavier than in wire nails of corresponding lengths.

An outstanding property of the nail is that it is permanently rust proof and highly resistant to salt water and other agents of corrosion, including tannic acid. Thus it will not produce a stain to discolor the wood into which it is driven.

CAMERA ANGLES

Conducted by JACOB DESCHIN, A.R.P.S.

Careers in Photography

HOBBIES frequently lead enthusiasts to full-time trades and professions. This is particularly true of photography, especially since it may often be used in combination with some other activity either in an auxiliary capacity or as the main vocation. Some of the numerous fields in which photography plays or can be made to play an important part were discussed at a recent Conference on Photography held in New York City under the auspices of the Institute of Women's Professional Relations, of Connecticut College. Although slanted from the point of view of the girl graduate in search of a job, most of the speakers described the requirements and opportunities in their several fields as they applied to all beginners without regard to sex.

By Martin Langan, from the Fourth International Leica Exhibit
Professional: Portraiture

More than 20 major photographic fields were discussed by authorities in each field, but the general opinion seemed to be that the photographer who desires to make a success of his chosen profession must have a good technical training, good general background, and a good knowledge of the particular field in which he expects to work. In addition to mastering the technical problems of photography in his field, said Roy E. Stryker, Chief, Historical Section, Bureau of Information, Farm Security Administration, the photographer "must recognize that photography is a product of the intellect rather than a product of mechanical skill." Mr. Stryker, covering the subject of "Photography in Social Science Research," said: "In order for the Farm Security Administration photographers to do their camera reporting they must be something of sociologists, economists, historians. That they be expert camera craftsmen is taken for granted. That they have a good general background coupled with the faculty for acquiring a working knowledge of a variety of subjects is essential."

Nor did the speakers fail to warn prospects that photography is not easy work, particularly in the news-picture field. "Camera work has its share of heartaches and disappointments," said William Eckenberg, of *New York Times* Rotogravure. "One must be ready at any and all times to work 24 hours and more at a stretch and often go without food. News photographers must be hardy enough to withstand all kinds of weather and abuse. Many of them have sacrificed home life and even life itself, in the pursuit of news pictures."

To beginners looking for an opening, Miss Jackie Martin, A.R.P.S., Photographer and Art Director of the Washington *Times-Herald*, speaking on "News Photography and Photo-Editing," gave the following sound advice:

"I should think the best chance for a job would be a small finisher or portrait studio, free lancing for papers or magazines (this very small pickings, however), join camera clubs, submit prints for exhibits, get jobs in photo stores which are hopping up like mushrooms. Develop ability to write and make pictures, for the coming of tabloid type or caption type of story makes that an ideal combination. I think the big thing is to learn about photography, be trained, and the opportunity to work at it will follow."

Although the conference was slated to discuss photography as a means of recreation as well as a profession and an adjunct, only one speaker discussed the recreational aspect. This was Frank Liuni, president of The Photographic Society of America and The Metropolitan Camera Club Council, who described photography as "an indispensable adjunct to a wider enjoyment of life, even if one does not aspire to technical or artistic excellence."

The value of a good working knowl-

Courtesy Devin Colorgraph Corp.
Adjunct: Illustration

edge and scientific background in the particular field chosen by the photographer was patent in the very subjects discussed by the various speakers. These included papers on photography in biology and medicine, by Earle B. Perkins, director, Rutgers University, Department of Biophotography; chemistry, by Wanda K. Farr, director, Cellulose Department of the Chemical Foundation, Boyce Thompson Institute for Plant Research, Inc.; "Photography in Industrial Research," by John Mills, director of publications, Bell Telephone Laboratories; "Cinemanalysis: A Psychological Research Technique," by Dr. Arnold Gesell, director of The Clinic of Child Development at Yale University; "Guidance Through Visual Expression," by Evelyn S. Brown, of Harmon Foundation, New York City; "Cinematography in Graduate Studies," by Robert Chambers, of New York University.

Other subjects covered included: "Aerial Photography as a Profession," by William H. Meyer, Jr., general manager, Fairchild Aerial Surveys, Inc.; "Photography in Advertising," by Walter B. Geoghagen, president of the Art Directors Club; "Civic Documentary History," by Berenice Abbott; "Theatrical Photography," by Florence Vandamm, F.R.P.S.; a talk on photography as a profession by Wynn Richards; "Women's Oppor-

Adjunct: Social

tunities in Public Service Film and Photo Agencies," by Arch A. Mersey, assistant director, United States Film Service; "Photography in the Library," by Ralph H. Carruthers, in charge of Photographic Service at New York Public Library; talks on various aspects of museum photography by G. Lauder Greenway, assistant secretary, The Metropolitan Museum of Art; Beaumont Newhall, The Museum of Modern Art, New York; and Iris Barry, curator, The Museum of Modern Art Film Library; "The Teaching of Photography," by Franklin J. Keller, principal, Metropolitan Vocational High School; "Photography in Education, Educational Photography and Teaching Photography,"

Recreation: Hobby

by Adrian Ter Louw, Eastman Kodak Company. Talks by Edward Steichen and Fairfield Osborn were discussed in a previous issue.

Moral: Use a Stop Bath

If you allow light to fall on film before it has been fixed, the inevitable consequence is a completely ruined film. At least, that's the way we have all been taught. However, all is not necessarily lost in such circumstances, as witness the experience of a friend who did that very thing and yet saved the day. After developing the film he poured the developer solution out of the tank and poured in the stop bath. Then he was interrupted by visitors and upon returning to the tank forgot that the film was in the stop bath, not the fixer, and opened the tank. He removed the films (he was developing filmpack) from the tank and found the tell-tale milkiness that indicated the films had not been fixed. He washed the films anyway and let them dry. About a week later(!), he attempted to mend matters by immersing the negatives in the fixer even at that late date, since there was nothing to lose and everything to gain. The result surprised him. The films "cleared" and became printable negatives. All thanks, of course, is due to the use of a fresh stop bath, which arrested development and turned failure into success.

Fine Grain, Germain

Designed by Morris Germain, A. R. P. S., "as a foolproof developer for students and serious minded amateur photographers whose efforts in compounding photo-chemical solutions need encouragement," his fine-grain formula, given below, has met with popular favor with amateur and professional photographers alike.

Water (125° F. or 52° C)	32 oz. or	1000 cc.
Metol	¼ oz. or	7 gm.
Sodium Sulfite	2½ oz. or	70 gm.
Paraphenylene-diamine (base)	¼ oz. or	7 gm.
Glycin	¼ oz. or	7 gm.

Mr. Germain, who is Technical Advisor for Penn Camera Exchange, New York City, gives the following instructions: "The use of distilled water is preferred. Dissolve the chemicals in the order listed. Use without dilution. For replenisher, use the same formula. Thirty-two ounces of this formula will

Fifth Annual Scientific American

AMATEUR PHOTOGRAPHY CONTEST

[For Complete Contest Rules, See Page 94, August 1940 Scientific American]

OVER $1200 IN PRIZES

36 PRIZES *PLUS* Three Special Awards

IN this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules. In addition to the seven major prizes and five honorable mentions, there will be three SPECIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners. *These special awards will be given in addition to the regular prizes that the pictures win.*

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

Division 1. Human interest, including camera studies of people, animals, and so on. Portraits will be grouped in this division.

Division 2. Landscapes, including all scenic views, seascapes, and so on.

Division 3. Action, including all types of photographs in which action is the predominating feature.

THE PRIZES

1st. Three $125 LONGINES, Coronation Model, Solid Gold, Men's Wrist Watches.

2nd. Three $85 LONGINES, Presentation Model, Solid Gold, Men's Wrist Watches.

3rd. Three FEDERAL No. 246 Photo Enlargers (List Price $49.50).

4th. Three FEDERAL No. 345 Photo Enlargers (List Price $42.50).

5th. Three PIERCE CHRONOGRAPH Men's Wrist Watches (List Price $19.75).

6th. Three BERMAN-MEYERS Flash Guns complete with case (List price $15).

7th. Three FINK-ROSELIEVE Vaporators (List price $12.50)

HONORABLE MENTION

1st. Three Fink-Roselieve "Hi-Spot" Hollywood type spotlights.

2nd. Three Mimosa Perkino developing tanks.

3rd. Three Raygram Wood-Chrome Tripods.

4th. Three Fink-Roselieve Audible Timers.

5th. Three Fink-Roselieve Satin-Chrome Range Finders.

THREE SPECIAL AWARDS!

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest. To the contestants who entered these three photographs will be presented the following special awards:

1st. One No. 715 Weston Exposure Meter (List price $24.)
2nd. One No. 650 Weston Exposure Meter (List price $19.95.)
3rd. One No. 850 Weston Exposure Meter (List price $15.50.)

THE JUDGES:

McClelland Barclay, artist
Ivan Dmitri, artist and photographer
T. J. Maloney, editor of U. S. Camera
Robert Yarnall Richie, photographer

Address all Entries to

Photograph Contest Editor, Scientific American

24 West 40th Street New York, N. Y.

develop 12 to 18 five-foot rolls of 35 mm film or its equivalent in area. The developer should be filtered after compounding and again thereafter, each time before use. This will insure against 'pin holes' from foreign matter or normal precipitates that may be present in the developer solution."

Among the advantages listed for this developer are good keeping qualities, maintenance of energy over a longer period of time with consistent use, no extra exposure compensation required. Developing time is 8 to 10 minutes for film having Weston rating under 50; 12 to 15 minutes for Weston rating above 50.

One Subject, Many Pictures

THE most obvious truths of photography have to be repeated now and then because people seem to forget them so easily. As a result, they overlook pictures that are right before their eyes, but take some study to see. One of these truths is that a single subject may offer more than one shot. Mrs. Alterman, of Mount Vernon, New York, may have been thinking along these lines, or perhaps it was simply because she liked the particular spot, when she planned and shot a series of pictures around a certain wood fence.

Two of these pictures are reproduced here. Each one is distinctly different from the other. It was just a matter of changing the viewpoint. Personally, we like the close-up shot better than the "long" shot of the fence. But that is just a matter of opinion. In any event, a series would necessarily call for the inclusion of whole subject in at least one of the pictures, which may then be supplemented by close-up views of details.

In addition to viewpoint, there is also the opportunity of photographing the subject in different seasons. Mrs. Alterman has done this as well, photographing the scene in the fall and again in the winter with snow instead

From one viewpoint . . .

. . . and from another

of fallen leaves to identify the season.

This kind of photography is a sort of exercise which every worker should now and then indulge in even if he never shows the results. It is the kind of experimentation that will stand him in good stead when the "real picture" comes along.

Solution Bottles

RECENTLY we came across some empty gallon size brown bottles used by manufacturing chemists for packaging their chemicals, that struck us as being admirably suited for storing or mixing photographic solutions. The large Bakelite threaded cap is about an inch deep, has a wax coating at the bottom of the cap to preserve the contents of the bottle, and the neck of the bottle is designed with an indenture at the edge to hold the bottle on the rim of the graduate or bottle into which the solution is poured.

If you have a chemist friend by all means get him to let you have one or more of these bottles as he empties them. If he can spare them, of course. They seem ideal for mixing large quantities of solution for distribution among several smaller bottles, or even for storing solutions. One worker mixed a gallon of paper developer in one of these and used the bottle for storage. Although he kept pouring from the bottle occasionally over the course of several months, gradually depleting it, there seemed no evidence of serious oxidation.

Daumier and Candid Photography

COMMENTING on a group of Daumier's sketches as paralleled in the work of some of today's candid photographers, Ralph Steiner, writing in a recent issue of *PM*, remarked on the similarity in viewpoint of the artist and the photographer.

"The candid camera photographer today can catch in a fraction of a second a gesture, an expression or a pose that the painter may labor over for hours," writes Mr. Steiner. "But just because the painter works slowly, he is more likely to choose significant gestures—ones that express the relationship of people to each other, or that express their feelings, thoughts, characters.

"This should be the job of the candid photographer also, but too often today he is interested only in the fact that he can take the picture at a 1/1000th of a second, and catch an accidental gesture, like the politician de-waxing his ear.

"The good candid photographer should play the same part as a recorder of human thoughts and feelings as a painter such as Daumier played for his time."

Kalart Contest

MORE than $500 in merchandise prizes is offered by The Kalart Company, Inc., 915 Broadway, New York, N. Y., for pictures taken with a Kalart Speed Flash, both outdoors by the Synchro-Sunlight method, and indoors. This year's contest, which is wider in scope than in former years, offers a total of 35 grand prizes including an Anniversary Speed Graphic as the First Grand Prize, a Simmon Super Omega B Enlarger, a Solar Enlarger, a Federal Enlarger, a Kalart Lens-Coupled Range Finder, and other prizes.

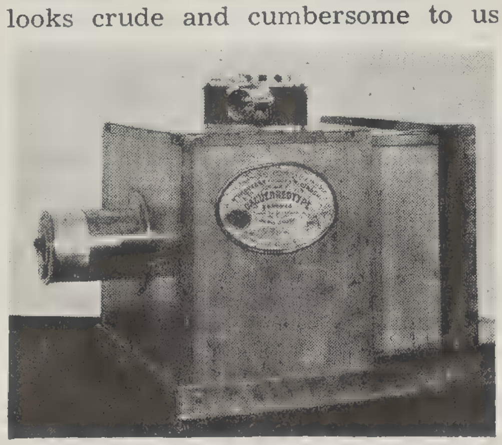
Any number of prints may be submitted, either mounted or unmounted.

In addition to the 35 Grand Prizes, the Kalart company each month will award a case of Wabash flash bulbs and a new Kalart Concentrating Reflector for the best photograph received during each of the following months: August, September, October, and November. All entries received up to and including the last day of these months are eligible for the monthly prizes. Speed Flash photos winning monthly prizes will also be eligible for Grand Prizes.

The contest closes at midnight, December 1, 1940. Entry blanks are available from photographic dealers or by writing to the company.

100 Years of Progress

A HUNDRED years ago and today in photography is strikingly illustrated in this picture, which needs no caption. A Daguerreotype camera that was all the rage a century ago looks crude and cumbersome to us



Then . . . and now

today, accustomed as we are to the finest of precision cameras. The implication is, of course, that we feel mighty proud of our accomplishment. But we must consider that had it not been for the Daguerres of yesterday, photography might never have achieved what it enjoys today.

Window Reflections

What you see, you can photograph. This is not always appreciated by the amateur worker as much as it should be. For example, a reflection in an open window of the sky opposite

Reflection

to that part of it which you happen to be facing, can be photographed, as it was in the accompanying illustration. You will notice that the reflected part shows up bright and properly exposed, while the portions faced directly by the lens are overprinted. This is, of course, due to the fact that the reflected buildings were lighted by the sun.

The Lens Club

Described as "the most unusual camera club in the world," the Lens Club, whose headquarters are at 165 West 46th Street, New York City, is out for members. The club hopes to serve as the national headquarters for the professional photographer and pioneer in the industry. Its first objective, however, is to help its amateur members to perfect their technique and provide working facilities.

Chief responsibility for organizing the club is credited to Herbert Mitchell, known as the "Photographer of Celebrities," and a list of distinguished names constitutes the Advisory Board.

The club is characterized by its sponsors as "three clubs in one," combining the best features of the camera club, the social club, and the luncheon and dinner club. The clubrooms are the former home of the Motion Picture Club, occupying over 13,000 square feet of space.

When completed, the announcement says, the club's facilities "will include a studio fully equipped for black and white and color work, darkrooms and finishing rooms, lockers and dressing rooms, showers, beauty parlor and barber shop, projection room and library, spacious and comfortable lounge, meeting room and exhibition room, dining room and kitchen, private bar, bridge and backgammon rooms." The formal opening will be September 1st, 1940.

Particulars may be obtained by writing to the club.

Cut Film Sizes

Those who use the so-called 2¼ by 3¼-inch cut-film size will be interested in the following letter recently received by this department from Lloyd E. Varden, A. R. P. S., of Agfa Ansco:

"It has come to our attention repeatedly that there exists a general confusion in the two cut-sheet film sizes 2½ by 3¼-inch and 6.5 by 9 cm. These two sizes, although representing a difference of only .06 of an inch in width and .04 of an inch in length, cannot be used interchangeably. This applies both to the sheet film holders and to the film.

"All sheet films are normally cut slightly smaller than their stated dimensions, in order to make them fit easily and smoothly into their holders. The actual sizes are standard among American film manufacturers. Discrepancies that have arisen in sheet-film sizes have been due mostly to camera importations, but no trouble will result providing consumers make sure to get the right size for their particular camera."

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WHAT'S NEW

In Photographic Equipment

Dejur Versatile Enlargers: Series will take in negative sizes from 1 by 1 up to 5 by 7. Model now available takes negatives 1 by 1 to 2¼ by 3¼. May be used as enlarger, camera for copying, camera for tabletop photography, camera for photomicrography, camera for portrait and still life photography, for Kodachrome and other three-color work, for transparency projection at any angle. Completely ventilated housing utilizes "Aero-Teck" design permitting only minimum heat to reach negative plane.

Lafayette Port-O-Lab Kit ($8.89, complete): Complete darkroom set-up for developing and contact printing in handy airplane-style luggage carrying case. Maker suggests its use for developing and printing test prints while "on location," as well as convenience in small apartments where space is at premium. Kit contains Bakelite roll-film tank for all sizes from 35mm to 116 size roll film;

printing frame; developing trays; contact paper; darkroom bulb; all chemicals and bottles necessary for complete work. Carrying case measures 20¼ inches long; 13 inches high and 7¼ inches deep; weighs about 14 pounds including materials.

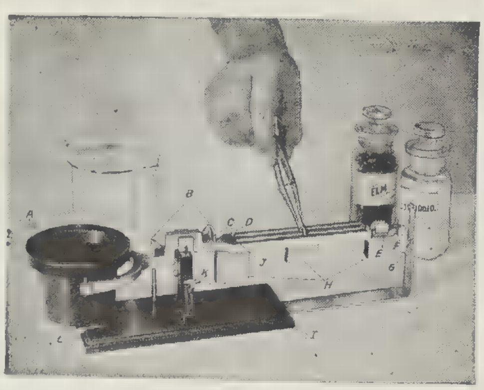
LITTLE TECHNICAL LIBRARY (50 cents per book): A second series of books on various phases of practical photographic work, just issued by Ziff-Davis Publishing Company. Each volume covers a separate subject and is written by a practical worker in the field. The second series begins with book No. 11, "Outdoor Photography," by Samuel Grierson, and concludes with book No. 20, "Darkroom Handbook And Formulary" by Morris Germain, A.R.P.S. The others include No. 12, "Indoor Photography" by Hillary G. Bailey, F.R.P.S.; No. 13, "Flash Photography," by Russ Arnold; No. 14, "Photographing Action," by Victor De Palma; No. 15, "Manual of Enlarging," by Stephen White, A.R.P.S.; No. 16, "Miniature Camera Technique" by Fenwick G. Small; No. 17, "Photographic Lenses and Shutters," by Richard W. St. Clair, A.R.P.S.; No. 18, "Photo Tricks and Effects," by Jacob Deschin, A.R.P.S.; and No. 19, "Selling Your Pictures," by Kurt S. Safranski. Each book is bound in stiff covers and contains about 25,000 words of text matter, illustrated.

GEM FILMOLAC (60 cents): Preservative for cine, still, and reversal film, against scratching, finger marks, brittleness, and curl.

BESBEE CLOSEUP COMBINATION KIT ($3.75): For movie closeups of small objects, indoors and out. Designed to work with any movie camera in making closeups of flowers, small birds and animals, botanical details, insects, and so on. Kit consists of tripod table, which also can be used with camera handle (supplied); adjustable lens holder, universally adaptable to any 8mm or 16mm camera; and two closeup auxiliary lenses, giving sharp closeups of objects at distances of 10 to 30 inches. Additional lens auxiliaries for other distances available in special assortment of six closeup lenses ($4) for distances 7, 12, 15, 18, 24 and 27 inches.

ELKAY FOTO-PURE WATER FILTER ($3.50 complete): Designed to remove impurities in ordinary water. May be attached to any faucet. Outside made of Bakelite. Inside consists of series of five metal screens, plus patented Cellulo fiber filtering disk.

F-R DEVELOCHROME ($.75 per 4-oz. bottle; $.75 per can special developer): Direct color toning developer for prints, created by Anton Bruehl, well-known American photographer. Permits development of print to a colored image in any one of six colors. Variations of obtainable colors endless, is manufacturer's claim, "de-



pending only on the ingenuity of the photographer." Available colors: three basic and three additional from which various combinations may be produced. Colors are red, yellow, blue, sepia, sea green, snow blue.

SAYMON-BROWN RANGE FINDER ($15, including installation): Couples directly to lens standard of Speed Graphic, Bee Bee, Linhof, Ihagee, Recomar, Jewel, and similar cameras, as well as many postcard-size roll-film cameras. Design: correct optical balance of mirrors, which are made tarnish-proof and permanent by same process used for observatory telescope mirrors; provides brilliant illumination of images even in adverse light or at night. Center object of amber color to make quick, accurate matching of images for all distances from 3 feet to infinity. Finder measures 3⅛ by ⅝ by ¾ inches; weighs 2½ ounces. Finished in satin chrome. Guaranteed by makers. Installation can be made through regular dealer.

SPEEDGUNS DELUXE "C" JR. AND "C" DELUXE, for Miniature Speed Graphic and larger Speed Graphics, feature completely open bulb clamp, with positive ejector. Head of gun redesigned for proof against rain. Battery case fastened to camera by means of new bracket. Flip of thumb tightens case against improved clip. "Shake it up or down, back or forth—you can't budge it," declare the makers. Flip thumb again and case is free. Other features include positive switch button and safety switch button guard.

HAYNES SHUTTER CHECKER (50 cents): For testing accuracy of between-the-lens shutter. Used with any phonograph turntable. Stroboscopic ring assures correct rate of turn. No calculations required for speeds from one-half second to 1/500th.

16MM FILMO TITLER: For use with all Filmo 16mm cameras. Features "visual centering" arrangement permitting titles to be centered accurately through viewfinder of camera. Titler consists of camera carriage, title-card carriage, two swiveled reflectors, each unit sliding upon connecting track and clamping firmly in any position. Title can be used horizontally or vertically, as an animation stand or to permit filming title actually being written by human hand. Reflectors adjustable and made to take No. 1 Photofloods.

AGFA MEMO WITH LENS F/5.6 ($14.50): Memar f/5.6 anastigmat focuses from 3½ feet to infinity. Shutter speeds 1/25, 1/50, and 1/100 of a second, plus Time and Bulb. Compact, steel construction. Provides Memo-type rapid film transport mechanism. Loads with standard Agfa Memo cartridge, 24 double-frame size pictures (1-7/16 by 15/16ths inches) per cartridge. Other features include: brilliant, optical, di-

rect view finder; tripod socket, cable release socket; neck-cord eyelets, automatic exposure counter. Accessories available: leather eveready carrying case; filters—yellow, red, and green; sunshade; neckcord; cable release; tripod.

PHOTO-ART DODGER (75 cents): Contains number of apertures of various sizes and shapes which can be further modified by rear plate into many series of patterns. Useful for localized spots, special effects, vignetting. Diameter of dodger 14 inches. Complete instructions printed on upper surface of dodger.

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THE ROUND TABLE

Questions Answered for the Amateur Photographer

Q. **What characteristics are lost when an anastigmat lens is "stopped down." I know that the depth of field is increased. Does the lens lose anything if focusing is accomplished by moving the front part of the lens while the back element remains fixed?—E. J. T.**

A. Stopping down may cause a softening, that is, slight off-sharpness of the image, as compared with the image when focused at a larger opening, but this is usually of no practical consequence. Besides, the advantage of depth of field, where this is required, far offsets the above disadvantage. Opinion varies concerning the advisability of the method employed on some lens mounts by which the front element is moved back and forth in focusing while the back element remains unmoved. One of the best known cameras of today enjoys a wide popularity both among advanced amateurs and professionals, who usually are very exacting, despite the fact that it employs this method of focusing.

Q. **In using an exposure meter it is recommended that it be held near the object. Since the intensity of light varies inversely as the square of the distance I have not been able to figure out why a foot candle reading close to the object is just as applicable in calculating exposure time, and stops, when using the camera close up as it is when using it at several feet distance. Just why is there no distinction made?—G. O. L.**

A. The "square of the distance" which you mention has reference to the distance between the subject and the source of illumination and not the distance between subject and camera. Therefore, provided the light remains the same distance from the subject, it would not matter how near or how far you held the meter from the subject were it not for this important factor: an exposure meter covers a wider angle of view the farther it is held from the subject, with the consequence that the resulting reading takes in not only the light reflected from the subject but also that reflected from the surrounding area. If the meter's angle of view could be cut down so narrowly that, even at the position of the camera, only the light reflected from the subject would be included, there would be no necessity for approaching the subject closely, and the reading would be the same, whether held close up or at the camera position.

Q. **Please state if the old type Petzval lens is achromatic. I want to use this lens for a terrestrial telescope even though the focal length is 24 inches.—A. T.**

A. The Petzval lens is semi-achromatic, not fully corrected for color aberration, but sufficiently so for the purpose you have in mind.

Q. **I have been advised to use a Polaroid filter to eliminate reflection. I notice that when the filter is turned in the housing, the field darkens and appears to have a purplish cast. Will this affect the natural colors on Kodachrome Type A film? Also, how effective is the filter for the purpose, and what changes in exposure time will be required?—S. A. R.**

A. The darkening of the field is caused by a reduction in the amount of light admitted, and will not affect the color rendering of Kodachrome. The effectiveness of the Polaroid filter in eliminating glare and reflection has been proved by many workers who have used this screen, as it is more properly called, both with Kodachrome and regular black and white film. Because the light is cut down, the exposure time should be twice that required without the screen.

Q. **Is there any type of successive flash equipment that would enable me to get several shots of wild life in the woods after dark within about 15 to 30 seconds?—G. W. T.**

A. By operating very quickly, you could probably get a few shots within this period with regular flash equipment and provided the camera film advance is of the automatic type. If your flashgun head is of the bulb ejector type, speed would be facilitated. There is soon to appear on the market a multiple flash gun taking as many as a dozen G. E. No. 5 "Midget" bulbs, which may be fired successively one after the other in synchronization with successive films. This will probably be most useful for your purpose.

Q. **Can you furnish information on home development of movie color film?—R. S. M.**

A. The only motion picture color film that may be processed at home is Dufaycolor. Details may be obtained by writing to the manufacturers, Dufaycolor Co., Inc., 68 West 48th St., New York City. A drum recently placed on the market called the Graphic Reel can be used for processing. It has a capacity of 32 feet of 16mm or double 8mm film.

YOUR FIREARMS and FISHING TACKLE

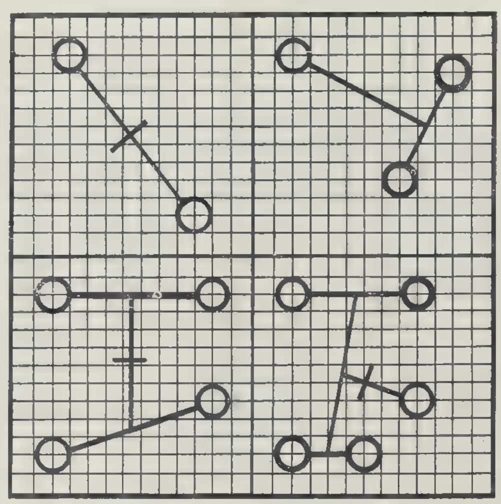
Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; fishing tackle is a requisite of one of the world's oldest occupations. Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department which welcomes correspondence from readers.*

Center of Impact

IN the belief that many shooters have wished for a simple, easy formula for locating exactly the average point of strike, or "center of impact," of a group of shots when targeting a rifle or pistol in sight alignment, Walter T. Gorton, of the Springfield Armory, Springfield, Massachusetts, sent us a suggestion accompanied by drawings. Mr. Gorton has so ably expounded his idea that we'll let him tell it in his own way, with our sincere thanks for his interesting contribution.

"It is not difficult," writes Mr. Gorton, "to determine the location of the center of impact by averaging the horizontal and vertical locations of a group of shots by measuring from suitable vertical and horizontal reference lines, such as the edges of the usual paper target, but this process is rather slow and inconvenient. Since a single shot is not conclusive for targeting purposes, a group of shots is necessary, and the smallest group, of course, is two, which, while more conclusive than a single shot, is still rather small. The center of impact of a two-shot group is very easily found, as obviously it lies exactly half way between the two. (Figure 1)



Upper left, Figure 1. Upper right, Figure 2. Lower left, Figure 3. Lower right, Figure 4

"This principle is easily and conveniently applied to larger groups. Three shots form the smallest group which is reasonably satisfactory for targeting purposes. To get the center of impact of such a group, first find the mid-point of the line joining any two shots. The center of impact for the group lies one third of the way along the straight line from this point toward the third shot. (Figure 2). Three-shot groups will do fairly well, but four-shot groups are better and can be measured quite as readily. Simply join any pair of shots with a straight line, and the remaining pair likewise. The mid-point of the straight line joining the mid-points of these two lines is the center of impact of the group. (Figure 3.)

"The orthodox five shot group also can be measured very easily, so the shooter who must have a group of this size can fire his five rounds cheerfully, letting them fall where they will. To measure the group, first locate the center of impact of any four shots as above described. One fifth of the way along the straight line from this point toward the fifth shot is the center of impact for the whole group (Figure 4), and this method can be applied to groups of any size, by working in successive steps. A geometric principle, the process boils down to this: Consider the individual shots to be small bodies of equal weight lying in the plane of the target. The center of impact of the group is the center of gravity of this system of like bodies. Figures have been drawn on coordinate paper so that skeptics may readily verify the plotted location of the center of impact in each case by finding the average horizontal and vertical locations of the various shots. A graphic check, also, may be made in all but Figure 1 by starting with other pairs of shots."

Back-Woods Are Closer

IF it were not for technological progress in the realm of marine motors, a lot of us who like to angle for the big ones back in the wild country might find ourselves handicapped in fulfilling our piscatorial desires. True, the ancient and honorable method of canoe travel is still to be relied upon and is particularly applicable to the fisherman whose budget is more limited than is his time. The airplane is our modern way of getting into the bush, but it does reverse the aforementioned budget-time premise. Due to scientific advances in outboard motor manufacture, however, we now have a middle-of-the-road method which saves time, costs next to nothing and is as reliable as the powerful motors which wing over forest and lake. Today we can answer "the call of the wild" just as we always have by stowing our duffle into the old canoe. But, by adding only a relatively few pounds to the total weight of our outfit, we can save lame

muscles, blistered hands and many hours—in which to get in more fishing. Here's how it's done.

Let's assume we're headed for the Lake of the Woods sections, or northwestern Quebec, where chains of lakes connected by small streams or short portages will lead to the lair of the muskie, the wall-eye, or the great northern. If we take along an Elto Cub outboard motor, for example, made by Evinrude Motors, we add only 8½ pounds to our load. A special

With an 8½-pound outboard motor and a few gallons of fuel, the hunter or fisherman can save much back-breaking work

bracket for canoe attachment is a couple of pounds more and packs easily. The motor runs 10 hours on a single gallon of fuel, will propel two men and their duffle in a canoe up to five miles an hour. As a conservative figure let's say we average 3½ miles per hour on lake travel, which comes to 35 miles for our first gallon of gasoline consumption and is probably a greater distance than a couple of city-softened outdoorsmen can hope to cover by paddle on the first day out. Without straining our backs too much we can pack in four extra 1-gallon tins of pre-mixed motor fuel, a total weight at the start of about 32 pounds, and we are assured of a minimum of 175 miles of motorized canoe travel. Based on our own experience of many thousand miles in a canoe, upstream and down, with the wind and against it, we believe a 25-mile-a-day average by paddle is about all two soft-muscled men can hope to accomplish. If we cover the same distance by motor in five days, instead of the seven required by paddle, we'll have two days more in camp, and it has cost us a little over $25 for the motor and about two cents an hour for its operation.

As noted above, the modern outboard motor is a far cry from its early ancestors in power, dependability, and weight. With Evinrude motors, for instance, the "dynamometer test" is used to establish power ratings. To insure absolutely impartial results, Evinrude has all models tested by The Pittsburgh Testing Laboratories, whose results are submitted to The National Outboard Association for final certification before being used by the manufacturer. Dependability and further protection are afforded through a policy of measuring horsepower at engine speeds recommended for constant service, rather than peak horsepower attainable, thereby assuring long hours of continuous and uninterrupted operation. As to weight, anyone who used to strain his back in order to install an outboard of 20 years ago will recognize the portability and adaptability to fishing trip usage of an 8½-pound motor which develops .5 N.O.A. Certified Brake H.P. at 4000 R.P.M. Yes, in these days the back-woods and the big fish are closer, and it costs very little to get there, thanks to American ingenuity and scientific progress in outboard motor building.

POT-SHOTS
At Things New

Marlin Firearms Company answers the country-wide demand for a rifle to use with the miniature clay target games, like Mo-Skeet-O and Targo, by developing a Recess Choked, Smooth Bore .22-caliber single-shot rifle, expressly built for this purpose. With this new Marlin method of boring, it is said that the control of shot distribution gives the best potential target breaking spread at any distance from 30 to 45 feet, with as wide a pattern as possible without holes through which a target could escape. The gun is known as Model 100-SB, Bolt Action, Single Shot Rifle.

Remington Arms Company announces Model 513T "Matchmaster" bolt-action .22-caliber target rifle, equipped with government type leather sling, adjustable for short or long armed shooters; Redfield front sight with seven interchangeable in-

"Matchmaker" comes complete

serts; Redfield No. 75 micrometer rear sight with ¼-minute adjustments; special target stock and pistol grip of dark finished American walnut with high, thick comb and long, wide beavertail fore-end; 27-inch, heavy, semi-floating barrel, double countersunk at muzzle, bored and rifled for extreme accuracy. "Matchmaster" has anti-backlash trigger stop for crisp, smooth trigger pull; short, fast, firing-pin travel; corrugated trigger; double

locking lugs on bolt and double extractors; firing indicator and positive side lever type safety. Butt plate is sharply checkered; front sling swivel is adjustable to arm length and barrel is drilled and tapped for scope blocks, with plug screws in holes. Detachable magazine box holds six cartridges and rifle is chambered for .22-caliber long-rifle cartridge. Over-all length of gun is 45 inches; taken-down length, 33 inches. Moderately priced, the "Matchmaster" is ideal for four-position shooting.

MOHAWK PRODUCTS, makers of that unique and rather revolutionary "Peep-Scope" we recently told you about, announces a reduction in price from $5.00 to $4.25. It seems the "Peep-Scope," which, through its one-inch length provides a telescopic effect by use of precision ground lenses, has met with such cordial reception from riflemen that increased sales and wider distribution brought about the lower price.

AMERICAN OPTICAL COMPANY presents scientifically designed, streamlined shooting glasses fitted with special Calobar or Noviol lenses to cover all conditions for hunters, marksmen, trap and skeet shooters. For all 'round

eye protection, good visibility, particularly in bright sun, Calobar lenses are recommended as reducing glare, absorbing the tiring, invisible infra-red and ultra-violet rays which cause eye strain and fatigue. Noviol lenses are counseled to obtain sharper detail on dull, hazy days and both types can be ground to prescription for defective eyes.

O. F. MOSSBERG & SONS, INC., have a low-cost spotting 'scope to keep company with those fine new rifles we told you about last month. Their 20-power Model A "Spotshot" 'scope is light, sturdy, has achromatic objective lens 38mm in diameter, ground to .00001 of an inch, and is equipped with metal eye caps for both ends. Eye-piece lens is 10mm with micrometer focus adjustment. In black crinkle finish with chrome plated draw tube, it is 17 inches long extended, 12½ inches when closed, weighs 1½ pounds, and has field of approximately 7½ feet at 100 yards. A 2¼-pound folding aluminum alloy and steel stand offers rigid support, has screws for adjustments.

THE PARKER-WHELEN COMPANY, INC., formerly National Target & Supply Company, in presenting its 5th edition of Colonel Townsend Whelen's "Gun Handbook and Catalog," offers to the shooting fraternity one of the most comprehensive and authoritative volumes on firearms we have ever seen. Colonel Whelen, who needs no introduction to American shooters, had as his editorial associates three men whose names have long been synonomous with expert knowledge of guns and ammunition, namely, Colonel Julian S. Hatcher, Colonel H. P. Sheldon, and Major Charles Askins. Each has contributed a fund of factual information from the fields in which he is a nationally known authority. Colonel Whelen wrote the sections devoted to Small Bore Rifles, Game Rifles, Telescope Sights for Rifles, Pistol Marksmanship; Colonel Hatcher has exhaustively handled Revolvers and Pistols; Colonel Sheldon and Major Askins covered the shotgun field and marksmanship with the scatterload. There are also articles on cleaning and cleaning materials; receiver sights and binoculars; reloading tools; clothing and outdoor equipment; gunsmithing, and a particularly helpful article entitled, "Useful Information for Shooters." The book is profusely illustrated, includes prices of all equipment shown and sells for only 25 cents a copy.

SHAKESPEARE COMPANY, which for many year has been supplying innumerable anglers with "what it takes" to take the fish, offers an exceptionally fine 1940 catalog. If you haven't obtained yours, we suggest you do so before the fishin' season is a minute older, and then devote a pleasant hour or so to its perusal. You'll find it enticing, helpful, constructive, and educational, particularly the pages depicting methods used by Tony Acetta, U. S. Amateur Bait and Fly Casting Champion, who really "gets 'em."

THE TANGLEFOOT COMPANY offers welcome relief from mosquitoes and other pests to both angler and hunter through use of its new repellent. A safe, greaseless, non-irritating cream in generous size tube, Tanglefoot MosQUITo Repellent has added virtues of actually being fragrant, lasting, and harmless to the most delicate skin.

BILL DEWITT BAITS offers deep-sea anglers absolute freedom from rust or salt corrosion of hooks through use in their manufacturing process of "Z" nickel, a heat-treatable alloy of approximately 98 percent nickel. (See May, 1940, Scientific American, page 277). Clean barbs, toughness, springiness, and great tensile strength are all provided at low original cost, which, due to rust-free properties, is likewise last cost. From E. S. Russell, of Bill DeWitt Baits, came samples of hooks with invitation to immerse one in strong salt solution. We did. Together with an ordinary hook, it stayed immersed 18 days, came out absolutely clean, fresh, shiny. You should have seen the other hook!

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for.

WE PRESENT TELEVISION

Edited by John Porterfield and Kay Reynolds

PRODUCED in an endeavor to give the non-technical reader a complete survey of the television situation, this book presents a running story, beginning with the technique of television and carrying through studio operation, programs and direction, acting, and the financial problems. The text has been prepared by a group of specialists who are in direct contact with those phases of the work about which they write. (298 pages including a glossary of terms, 6 by 9 inches, illustrated with photographs and drawings.)—$3.10 postpaid.—*A. P. P.*

AMERICAN AVIATION DIRECTORY

IN the early days of aviation, the industry was so small that everyone in it knew everyone else. Now, aviation has grown to such immense proportions that it is impossible for any one person to keep track of organizations, companies, and personalities. The American Aviation Directory will, therefore, render a very valuable service and has been received with enthusiasm. The Directory is in a carefully classified form, covering aircraft manufacturers and their personnel, air lines and their personnel, accessory firms, schools, trade organizations, state and federal organizations, and so on. A useful alphabetical index is provided. Loose-leaf form.—Yearly Subscription, $5.00.—*A. K.*

LIVING LIGHT

By E. Newton Harvey, Professor of Physiology at Princeton University

THERE is a very great deal of scientific information in this book, which is divided into six sections, respectively on cold light, light-producing organisms, types of luminescence, chemistry of light production, physiology of light production, and the physical nature of animal light. Under each section the appropriate subject is developed in a full sweep of detail. A reader who had extracted from this book its whole content would know a great deal about cold light in all its aspects—physical, chemical, physiological, and even engineering. It is not a textbook but in its seriousness it comes nearer one than anything resembling a popularization, yet the language is as simple as possible. No such book, bringing all scattered data within a single pair of covers, has appeared in English in many years, nor is likely to appear in many more. The author, known the world over, is the foremost scientific authority on the subject, which he has pursued as a specialty in the field and laboratory for a quarter century. (328 pages, 6 by 9 inches, 80 illustrations.)—$4.10 postpaid.—*A. G. I.*

PHOTOGRAPHY, PROFESSION, ADJUNCT, RECREATION

Addresses by 24 speakers

DESIGNED to lay before the girl graduate the opportunities for work available in the various photographic fields, a Conference on Photography, Profession, Adjunct, Recreation, was held in New York under the auspices of the Institute of Women's Professional Relations, Connecticut College, New London, Connecticut. During the course of that conference, which was helpful to all young people without regard to sex, 24 speakers discussed almost as many photographic fields. Their addresses were compiled and published in the present work. Those seeking advice on how to make a "go" of photography should find considerable guidance whether one desires to make a profession of photography or to use it in conjunction with some other vocation. (Mimeographed; 135 pages.)—$1.60 postpaid. —*J. D.*

THE WESTERN ANGLER

By Roderick L. Haig-Brown

HERE are two of the finest volumes ever released on the lore, technique, and fascination of angling, and the public necessity for its continuance as a sport. The author's vast ichthyological knowledge enables him authentically to present the history, habits, and scientific development of native and imported British Columbia trout and salmon; to describe their diseases, their enemies and their propagative possibilities from first-hand information. There are a complete index and two appendices, the latter covering respectively British Columbia fly dressings and a formula for determining fish population of lakes. Printed on deckle-edged paper, with nine magnificent color plates of trout, salmon and flies and numerous other halftone illustrations in sepia, these beautifully bound volumes are one of the best buys to reach the mar-

ket in a long time. The edition is limited to 950 numbered copies. (Two volumes totaling 391 pages, 8½ by 11 inches.)—$25.10 postpaid.—*A. D. R., IV.*

AERONAUTICAL DICTIONARY AND REFERENCE LIBRARY

By R. Hartley, Jr.

MR. HARTLEY is a man of considerable experience in the production aspects of aircraft and as a teacher of practical aviation subjects. The terminology of aeronautics is constantly growing and outside of a short "Nomenclature for Aeronautics," published by the N.A.C.A., there is no English publication dealing with the terminology of this great new industry. Mr. Hartley's work will meet, therefore, a well defined need and will certainly be a help to students, mechanics, pilots, and many others. The 524 pages of the Aeronautical Dictionary are clearly printed and well arranged. Part I covers definitions, nomenclature, terminology, and phraseology. Part II, entitled "References," gives condensed but useful information on aviation engines and aluminum alloys. It also gives a brief chronological history of aviation.—$4.10 postpaid.—*A. K.*

SEX IN MARRIAGE

By Ernest R. Groves, Prof. Sociology, University of North Carolina, and Gladys Hoagland Groves

FOR the newly married, those about to be married, and those having marital difficulty because of sex adjustment. This book is neither very technical on the one hand nor shallow and superficial on the other, but seems to be aimed about at average people. It contains a good deal of good and sound information. (250 pages, 4¾ by 7½ inches, unillustrated.)—$2.10 postpaid.—*S. S. J.*

INTERIOR ELECTRIC WIRING AND ESTIMATING

By Albert Uhl, Arthur L. Nelson, and Carl L. Dunlap

THE latest principles of wiring for homes, apartment buildings, and factories, including permissible wire sizes, devices, conduits, and the like. Numerous illustrations show the manner in which wires or conduits are installed in any kind of building structure. The section on estimating is especially complete and forms are given to show an actual job of estimating. (342 pages, 5¾ by 8½ inches, numerous illustrations.)—$2.60 postpaid.—*F. D. M.*

THE SOUL OF THE UNIVERSE

By Gustaf Stromberg

AN attempt to erect a ladder between the worlds of physics and biology and a World Soul or God. Mainly the book discusses the former and, separate from the soul thesis which is to follow near the end, it is a competent,

lucid exposition of space, time, matter, and of gravitational and electric fields; also of heredity and genes and theories of the origin and development of life on earth. These lead to a discussion of mechanism, vitalism, and religion, all three of which the author considers valid, and thence through the development of the human mind or soul to a world soul. This book will appeal especially to those interested in science and religion and in the linkage that is built up between the two. The conclusions that the author, a member of the research staff of Mount Wilson Observatory, has reached through his study of the laws of the universe, make the book unusually interesting and worthwhile. (244 pages, 5¼ by 8 inches, three illustrations.)—$2.10 postpaid. —*A. G. I.*

REFINING PRECIOUS METAL WASTES

By C. M. Hoke

BASED on 24 years of experience in teaching jewelers, dentists, and small refiners how to refine their precious metal wastes, this book bears heavily on the practical. Gold, platinum, silver, alloys, iridium, rhodium, low grade wastes, equipment, processes, identifying, the stock pot, repurification, equipment, dealer list—these items selected from here and there in it give the scope of this useful treatise. (362 pages, 6 by 9 inches, illustrated.)—$5.10 postpaid.—*A. G. I.*

THE ROAD TO MODERN SCIENCE

By H. A. Reason, B. Sc.

HISTORIES often are regarded as dull but this is the story, not the history, of science from the crudest beginnings straight through to our own times. It is not, however, a fluffy kind of account but one containing much substance even though written in popular, readable style. (297 pages, 5½ by 8 inches, 76 illustrations.)—$3.10 postpaid.—*A. G. I.*

THE GUN COLLECTOR'S HANDBOOK OF VALUES

By Charles Edward Chapel

OF inestimable value to gun collectors, both amateur and professional, is this newest publication by the author of "Gun Collecting." (Reviewed in our issue of January, 1940.) This is the first comprehensive effort in the English language to catalog and evaluate firearms for the collector; to say it is successful is to put it mildly. Some 2000 antique and semi-modern pieces, over 500 of which are illustrated, are described in detail, and values for "good" and "fine" condition have been assigned. For those who collect old guns, or for those who would like to collect them, this publication is absolutely indispensable. (220 pages 4¾ by 7½ inches, 33 full page plates.)—$3.10 clothbound and autographed, postpaid; $2.10 paperbound, postpaid.—*A. D. R., IV.*

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

THING of first importance in a telescope is functional excellence, of course, but it is, however, nearly always possible, without compromising this quality, to combine attractiveness. By attractiveness some may mean decorativeness. This may have its place provided it does not run to over-decorativeness and to "gingerbread." Perhaps, however, the best source of that something which gives beholders an instinctive feeling of satisfaction in any machine or structure is good proportion of parts and of the whole.

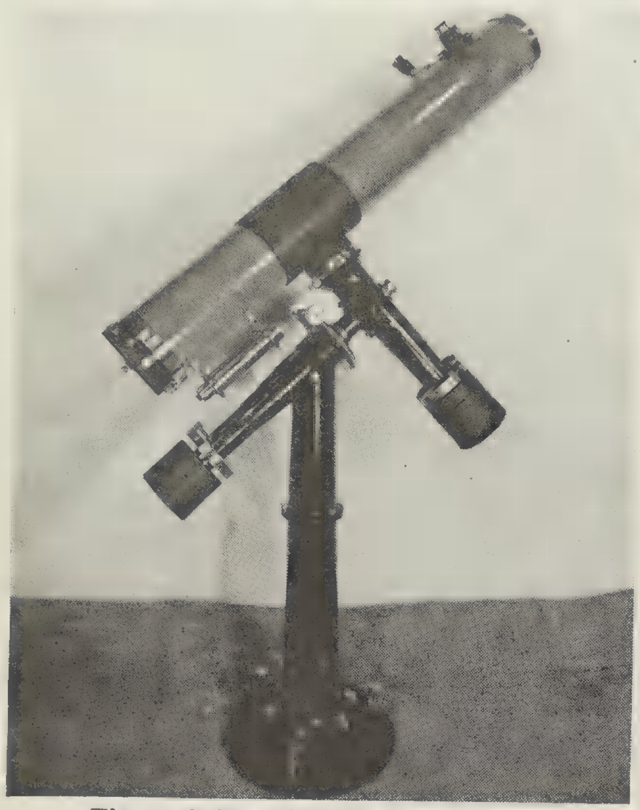


Figure 1: Hopkins' pleasing design

It is a long time since this department has received photographs of so well proportioned a telescope, whether made by amateur or professional, as the one shown in Figure 1. This 6" reflector was made by Edward Hopkins, 431 Fulton St., Elizabeth, N. J., who, according to our advices, is in charge of a machining department in one of the big airplane manufactories.

"The knowledge required to build this telescope," Hopkins writes, "came entirely from the Scientific American books 'Amateur Telescope Making' and 'Amateur Telescope Making —Advanced.' Its base was made from an old traffic sign, to which three leveling screws were added. The pedestal was converted from a truck torque tube. This was cut in two, and two flanges were welded on and machined, to permit the top section to be rotated slightly in order to line up the telescope.

"Atop the pedestal, the axle housing, from a Nash car, is slantingly welded on. The R. A. shaft turns on tapered roller bearings and is drilled through, so that Polaris can be sighted through a ring welded on the declination shaft. The declination shaft also turns on roller bearings mounted in a Model A Ford axle housing.

"The R. A. setting circle is graduated to units of 10′ and has a vernier to read to 1′; the declination circle to 1°, with vernier to 5′.

"The Bakelite tube can be turned in a split sleeve and is guided by two brass rings that were not yet on when the photograph was made. The mirror is Pyrex, of 48" *f.l.*, and is supported in the cell by a split brass ring with a cork insert. It is held by six screws around the edge, and behind by a triangular plate with three cork pads. The prism holder is universally adjustable.

"Accuracy in the working parts was held to a very high degree, the limits held as close as possible with precision measuring instruments.

"The whole thing handles easily and can be carried by a delicate woman, with the help of a strong man."

Not every amateur has access to fine machine tools or has had a chance to learn their use. Yet good proportion does not require these things; in fact, some who have them do not attain to it. Take, for example, the counterweights of this telescope, even though this is not a very vital part. If we were to make these only a few percent fatter and stubbier, or else skinnier and longer, the telescope would seem to one judge, at least, to have lost its fine figure, just as your scribe has. Maybe Hopkins just happened to have metal of these proportions but our guess is that he planned it so, as he did with other details.

Figure 2: Bohm's observatory

STONE is the chief material from which Anton Bohm, a monument maker, Apex Monument Works, 6815 W. 29th Avenue, Edgewater, Colorado, built his observatory (Figure 2). Its granite, brick, and stucco-lined wall is 12" thick and 8′ feet high (including the 2′ part that is hidden). The outside diameter is 12½′. Inside are three stone steps rising 24" to the concrete floor, with a trap door to cover the stair well, thus forestalling broken necks. In front is a low surrounding wall to contain earth for Mrs. Bohm's flowers and vines. Bohm says Mrs. Bohn helped him with the observatory by mixing concrete. The telescope pier goes 8′ below the surface. Absolutely no vibration is noticeable.

The dome is framed with 25/32" lumber and covered with 3/16" building board oiled three times inside and outside with linseed oil. To this, heavy canvas strips were added over the joints and the entire surface was given three coats of white outside paint. The shutters (Figure 3) are self-explanatory, also satisfactory. The acoustics inside the dome is fine; especially for people with squeeky voices, Bohm states.

A lead cable from the residence conducts current for light and drive. A temporary telescope is in use while Bohm patiently proceeds with a 12" reflector whose tube is shown in Figure 4. Each of the eight main struts of aluminum was cast in one piece from patterns previously made and used by Carroll C. Spencer, of the Spencer Laboratories, Denver. "Don't think the foundryman didn't cuss when casting the pattern eight times," Bohm writes. "He had to lie awake nights to figure out a way to prepare the mold so that the castings, with about ¾" shrinkage, would not break as they cooled." To clean up these castings, Bohm filed 15 hours on each strut! The rings are 14" brake drums from old Essex cars. The profile of the tube gives a feeling of nice proportion—or have we gone entirely mad on proportion?

Figure 3: Petal type shutters

In describing the Goethe Link Observatory, at Brooklyn, Ind., in the June number, Victor E. Maier, Director of the Observatory, mentioned that the Hartmann test of the 36" mirror was reduced by Dr. James Cuffy of Indiana University. Dr. Cuffy writes that, after becoming thoroughly conversant with everything in "ATM" and "ATMA," he was surprised to find that amateurs had almost no appreciation of the value of the Hartmann method of testing. He thinks this may have resulted from the brevity of the chapter on this test in "ATMA," so he wrote up the method as he used it, including short-cuts which he says simplify it enormously. His account, which ought to be in "ATMA," follows:

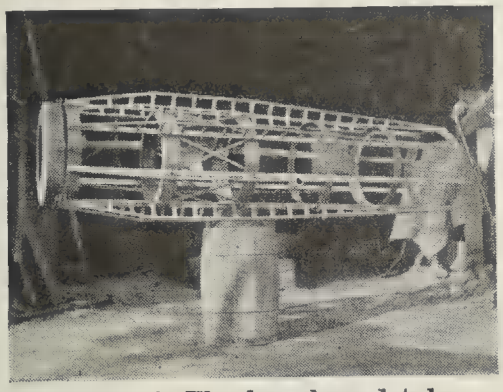


Figure 4: The leg-shaped tube

"The Hartmann method of testing optical surfaces has, apparently, been avoided almost entirely by the amateur astronomer. The avoidance may be due largely to the photographic technique involved, but also, I believe, to the implication ('ATMA,' page 109) that the Hartmann test is one applied to finished mirrors alone. Possibly the following paragraphs will serve to point out its value in testing a mirror at any stage of the figuring process.

"The advantages of the Hartmann method are: 1. Its complete objectivity; there is no judging of equal brightnesses for patches of light separated by considerable distances. The measurement of a radius of curvature is reduced to the measurement of a distance on a photographic plate. 2. The greater number of zones that may be tested at one time. To test numerous zones visually requires time, and fatigues the eye, whereas the Hartmann test gives the radii of as many zones as desired with a minimum of effort. 3. The more detailed knowledge of the deviations of the surface from parabolic, or other required surface, that results from testing many zones of the mirror.

"The disadvantages, as seen by the uninitiated, are the need for large numbers of photographic plates, especially since, in its conventional form, each test requires two plates, and the need for a comparator in measuring the plates. These objections, however, may easily be met. I am confident that, once the amateur has tried the Hartman test, he will be convinced of its superiority over visual zonal testing.

"In Hartmann testing, we place a perforated diaphragm before the mirror. The perforations are customarily placed along eight different axes of the mirror. The diameters of the holes are usually 1/400 of the distance from diaphragm to plate, and the centers of the holes are separated by approximately 2½ times the diameter of each hole. Naturally, it is only when testing for astigmatism that one measures all the axes of the mirror. The geometry of the test is shown in Figure 5. We are interested in obtaining the distances, d_1, from the plane of the photographic plate of the points where the rays from a given zone cross the optical axis.

"The first simplification we may make (see Danjon et Couder, 'Lunettes et Télescopes,' p. 507) is to dispense with one of the plates, and to substitute for it the diaphragm itself (at s_2). Since we have constructed the diaphragm with reasonable accuracy, we know immediately the values of a_2, or the separations of the two holes corresponding to the given zone. d_2 is then the distance of the diaphragm from the pinhole, or, with sufficient accuracy, the radius of curvature of the mirror. Thus, it is sufficient to take only one plate, inside focus, and to compute once and for all the factors d_2/a_2 by which the separations on the photographic plate, a_1, must be multiplied to give the distance from the plate to the intersections of the rays with the optical axis.

"The second simplification lies in the method of measuring the plates. Since the Hartmann pattern is usually only ½″ in diameter, we may use an ordinary photographic enlarger to enlarge the particular row of spots in the pattern to be measured up to about 10″ long (strips of bromide paper 1″ wide are sufficient). We then measure the positions of the spots with a good ruler. The scale of the enlargement must be known, and a simple method of determining the enlargement factor is to place a small piece of scotch tape of known width on the emulsion of the plate near the row of spots to be measured. We may then divide the separations measured with the ruler by the enlargement factor, in order to obtain the desired values of the a's on the plate.

"One could, of course, avoid photographic work entirely in making a Hartmann test by providing himself with an eyepiece micrometer having illuminated cross-wires; thus making settings of the cross-wires on the image of the Hartmann pattern directly without bothering to photograph it.

"It is important that the Hartmann diaphragm be held in a plane as close to the mirror as possible, and that the plate be perpendicular to the optical axis. If the mirror is of high aperture ratio ($f/4$ or less), the value of r for the zone being tested will differ slightly from the value of r measured on the screen, because of the inclination of the rays and the fact that the diaphragm is not in contact with the concave surface. Ordinarily, however, we may use r as measured on the diaphragm for computing the parabolic radii, r^2/R.

"The writer has used the Hartmann test as described above in testing the 36″, $f/5$ mirror for Dr. Goethe Link's observatory (Brooklyn, Indiana), and has found the method convenient and accurate. He had, however, access to a good measuring machine.

"Having obtained the values of the radii for a number of zones of a mirror, we may compare them with the computed values for a perfect mirror and predict the performance of the mirror in actual use. Thus, we may compute

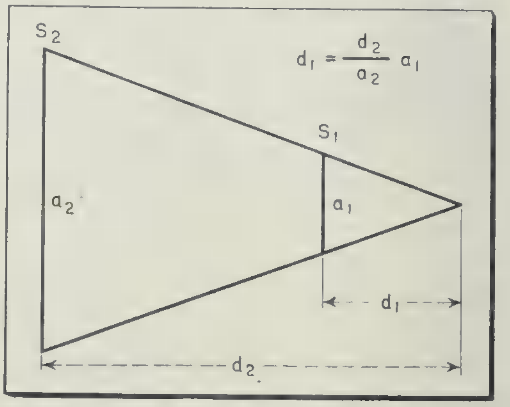


Figure 5: Geometry, Hartmann

the value of the Hartmann criterion, t, which is the weighted mean radius of the confusion disk, each zone of the mirror being weighted according to its light gathering power, or its circumference, since the area of any zone is proportional to its circumference. The value of t is given by

$$t = \frac{200{,}000}{F^2} \quad \frac{\Sigma r^2 \Delta F}{\Sigma r}$$

where 200,000 is very nearly the number of seconds of arc in a radian, F is the mean focal length, r is the distance of the zone from the optical axis, and ΔF is the axial error from true focus. All the ΔF's are taken as positive numbers; that is, we use their absolute rather than their algebraic values. If a mirror is to perform well, its Hartmann criterion must be less than its theoretical resolving power, or 4.5 seconds/aperture (inches).

"Most of the large mirrors at present in use have values of t between 0.1 and 0.2. A mirror larger than 24″ in aperture, and having a value of t less than 0.5, is just satisfactory for photographic work, but unsatisfactory for visual work. In fact, seeing conditions combine with photographic graininess and the diffusion of light in the emulsion itself to make star images less than 0.035 mm. in diameter rare, while under ordinary conditions the images obtained with a large instrument are usually between 0.05 and 0.10 mm. in diameter. It is thus evident that the demands for high optical quality are about five times as stringent in the case of a telescope to be used for visual work as for one intended primarily for photography. And therein lies the reason why the average astronomer is able to obtain plates of value on

nearly every clear night. The situation is perhaps best described by saying that seeing conditions are seldom too bad for photographic work, while they are seldom good enough for visual work, at least with high powered eyepieces."

WE keep hearing of more and more men who once were ordinary amateur telescope makers and who sweated over their first 6" mirrors, "even as you and I," now finding their permanent life work in optics as the ultimate outcome. Ralph Dietz is with the Mt. Wilson shops, two amateurs now are pros with Bausch and Lomb, while around New York are several who are regularly employed in professional shops. What is called the "Optical Division" of the American Astronomical Association is that fraction of The New York City amateur astronomers who enjoy getting their rougey hands on hunks of glass and converting them into telescopes and other things optical. Its organizer was Lew Lojas, and he, for the past three years or so, has earned his living as an employed professional. He is with the Kollmorgen Optical Co., 767 Wyeth Ave., Brooklyn, N. Y., where he polishes and corrects lenses. Edward Hanna, another Optical Division amateur, now is also with Kollmorgen, edging and inspecting lenses, while Walter Howland, from the same amateur group, is a Kollmorgen computer.

Working in the Jersey City shops of the Perkin-Elmer Corporation, of 90 Broad St., New York, N. Y., is Daniel E. McGuire, a typical amateur from a typical Ohio small town who went to the great city and who is running the polishers and correcting objectives; also Stanley Brower, who does blocking and works on magnifiers, eye lenses and microscope objectives. We hear there is an opening for one more good man in these shops.

In Keuffel and Esser's shops, at 300 Adams St., Hoboken, N. J., is another optical Division man, Carl Grosswendt, doing optical inspection.

Some of these men and others who may choose similar work stand a good chance of becoming leaders in the optical industry in later years.

We have received a letter from Frank A. Eaton, of the Bausch and Lomb Optical Co., Rochester, N. Y., who mentions the comments about war emergency optical jobs for amateur telescope makers, made here last month, and says: "We are interested in knowing sources from which applicants may be obtained in the future. While it is not our intention to encourage more people to come to the plant for interview at this time, since the numbers now applying far exceed any future employment we shall have for them, if the amateur telescope makers will merely write to us, so that we have their names and addresses on record, with an explanation of what they have done with optical grinding and polishing, that will be sufficient material for us to use in seeking later interviews."

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

Notice

A PATENTEE who does not manufacture and sell the patented article may recover profits and damages from an infringer even prior to the time that actual notice of infringement is transmitted to the infringer.

Much confusion has been caused by the provision of the statute which states that it shall be the duty of all patentees making or vending a patented article to affix thereto the required patent notice consisting of the word "Patent" followed by the number of the patent. The statute provides further that "in any suit for infringement, by the party failing so to mark, no damages shall be recovered by the plaintiff, except on proof that the defendant was duly notified of the infringement, and continued, after such notice, to make, use, or vend the article so patented."

It will be readily understood that where a patentee manufactures and sells articles under his patent he must affix the proper patent notice to the article in order to recover profits or damages from the infringer. Should he fail to affix the notice to the patented article he can only recover profits and damages accruing after the date on which notice was transmitted. Confusion has existed, however, as to those instances where the patentee did not manufacture and sell the patented article. Some courts were of the opinion that profits and damages could only be recovered after the date on which actual notice was transmitted, while other courts expressed the opinion that no notice was necessary.

This confusion was dispelled by a decision of the United States Supreme Court which, after reviewing the history of the statute, concluded that it was only intended to apply to those instances where the patentee manufactured and sold articles under the patent. Where no manufacture and sale took place the patentee could recover damages and profits, the Court held, even though no notice of infringement was transmitted to the infringer.

Early American

WHEN an application for the registration of a trade mark is approved and passed by the Patent Office it is published in the *Official Gazette* prior to the registration of the mark. Anyone believing that he would be damaged by the registration of the mark may, within 30 days of the date of publication, file a notice of opposition to the registration. When the opposition is based upon a prior trade mark owned by the opposer and the opposer charges that there is a possibility of confusion between his mark and the mark sought to be registered, the Patent Office resolves all doubts as to similarity between the marks and as to the possibility of confusion in favor of the opposer and against the applicant for the registration.

This principle is illustrated by a recent decision involving the trade marks "Elgin American" and "Early American." A manufacturer attempted to register the trade mark "Early American" for cosmetics and saponaceous materials. The registration was opposed by the owner of the trade mark "Elgin American" which was applied to vanity cases, face powder containers, and containers for other cosmetic materials. The Patent Office and the Court of Customs and Patent Appeals concluded that there was a possibility of confusion between the marks and, applying the rule that all doubt should be resolved in favor of the prior user of the mark, refused to permit the registration of the mark "Early American" for cosmetics and saponaceous materials.

Impatient

THE processes of the law are slow and inventors sometimes become impatient with its delays. In a recent case the applicant for a patent believed that another person had copied his invention and was infringing upon his rights. Instead of waiting for the issuance of his patent, he filed suit while his application for patent was still pending, charging infringement of the application. While the suit was pending the patent issued.

The alleged infringer of the patent then brought a motion to dismiss the suit on the grounds that the Court did not have jurisdiction because no patent was in existence at the time that the suit was filed. The Court granted the motion and dismissed the suit, holding that the issuance of the patent during the pendency of the suit did not correct the defect existing at the time that the suit was filed.

Trade-Mark Prints

THE manufacturer of a dress fabric containing a design based on well-known trade marks enjoined a competing manufacturer from selling fabrics containing similar designs. The

original manufacturer was licensed by the owners of certain well-known trade marks to use their trade marks under controlled conditions as designs for dress fabrics. The infringer used the same trade marks without permission from the owners thereof. The Court pointed out that the copying of a fabric design which is not protected by design patent cannot be restrained. However, in this instance the copying involved the use of well-known trade marks without the permission of the trade-mark owners. Under these circumstances the Court held that the unauthorized use of the trade marks as a design for a dress fabric constituted unfair competition and an injunction and an accounting were awarded.

Double Identification

An article of commerce may bear two trade marks and each mark may be separately subject to protection against infringement. This is illustrated by a suit involving the infringement of the trade mark "Friendly" for shoes. The manufacturer had used the trade mark "Friendly" together with the trade mark "Jarman" in the sale of its shoes. The defendant, a retail dealer, used the trade mark "Friendly" but not the trade mark "Jarman" in connection with shoes coming from another manufacturer. The dealer contended, among other things, that the trade mark "Friendly" was invalid because of its use with the other mark. It is also contended that to be guilty of trade-mark infringement it would be necessary to use both of the manufacturer's trade marks. The Court ruled that the trade mark "Friendly" was valid, that it denoted the manufacturer's goods, and that the use of this mark by the retail dealer constituted infringement.

Frozen Lollypops

The ice cream lollypops which are so popular with children were involved in recent patent ligitation. A suit was filed against a manufacturer of such lollypops charging infringement of two patents, one relating to the ice cream lollypops *per se*, the other to the method of making them.

In making the lollypop the stick was inserted in the ice cream at atmospheric temperature while the ice cream was in fluid condition. Thereafter the ice cream was frozen with the result that it adhered to the stick.

It was claimed by the patentee that this operation involved invention. The Court, however, declared the patent invalid, referring to the age-old custom of children of inserting sticks in a snowman and permitting them to freeze therein. In this connection the Court stated:

"It is childhood knowledge that the stick for a nose in a snowman, inserted in the afternoon, is so frozen to the icy snow particles, that, in the morning, young fingers cannot pull it out."

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

ADVENTURES IN CONVERSATION is a 24-page illustrated booklet that deals with the art of conversation and the stimulating effect which it can have on every-day life. A good conversaionalist can turn a dull subject into one that sparkles, can talk interestingly with conviction, can develop a personality which otherwise might be warped. The pathway to developing the art of conversation is found in this booklet. *Conversation Institute, 3601 Michigan Boulevard, Chicago, Illinois.—Gratis.*

ON THE JOB is a 32-page pamphlet that illustrates and describes more than 100 typical installations of Caterpillar diesel engines. These installations cover a wide variety of fields including uses by cities, hotels, quarries, and cotton gins. *Caterpillar Tractor Company, Peoria, Illinois.—Gratis.*

STEREOSCOPIC EYES, by Dr. C. F. Brindel, optometrist, is an 88-page book dealing with "how to see depth pictures without devices." It is Dr. Brindel's belief that with proper training of the eyes, it should become possible for anyone with "just a pair of good eyes" to dispense with a stereoscope when viewing stereo pictures. Dr. Brindel explains the physiology of the eyes and provides instruction and suggestions on how fusing of the two stereo images may be accomplished with the "naked eye." Well illustrated with diagrams and photographs. *Dr. C. F. Brindel, 27 West 10th Street, Anderson, Indiana.—$2.50.*

PHILIPPINE MINING YEAR BOOK is a volume of over 200 pages which surveys the entire field indicated by its title. It includes indexed sections covering the mining industries, mining companies, a mining staff directory, the Manila Stock Exchange, and a buyer's guide listing machine and equipment supply companies in Manila. *Mining Yearbook, Inc., P. O. Box 297, Manila, Philippines.—$1.00.*

BROWNING 5-10 METER CONVERTER is an extremely compact unit for receiving two frequency bands when used in conjunction with any mobile, home, or aviation receiver. This instrument is described in Bulletin 106, obtainable from *Browning Laboratories, Inc., 750 Main Street, Winchester, Massachusetts.—Gratis.*

ESSAYS ON HISTORICAL ANTHROPOLOGY OF NORTH AMERICA is a 600-page paper-covered book containing sections by outstanding American authorities on the early Indians of 15,000 years ago and later; archeology of the Southeast; Iroquois history; Great Plains Indians; Navahoes; Southwest and Great Basin Indians; also on Eskimo pre-history. Together, these chapters pretty well cover our present knowledge of the first Americans. *Smithsonian Institution, Washington, D. C.—$2.00.*

PHOTOGRAPHIC CHEMICALS, THEIR PROPERTIES AND USES, by Henry M. Lester, is a 32-page booklet reprinted from *Quarterly Supplement No. 3* to the *Photo-Lab Index*. Listing alphabetically the various chemicals used in compounding photographic solutions, this handy little guide includes for each of the chemicals, the chemical synonyms, chemical formula, common grades, uses. In the case of poisons it provides antidotes. The booklet lists about 400 chemical terms. *Morgan & Lester, 100 East 42nd Street, New York, New York.—50 cents.*

ADVENTURES IN BIOLOGY is a 101-page paper-bound booklet giving practical instructions for simple experiments in biology, mainly for teaching purposes. *New York Association of Biology Teachers, Mrs. Estella R. Steiner, Grover Cleveland High School, 2127 Himrod Street, Ridgewood, Queens, New York, New York.—50 cents.*

HIGHWAY RESEARCH BOARD, PROCEEDINGS NINETEENTH ANNUAL MEETING is a 578-page cloth-bound book that presents a wealth of information on various phases of highway design, economics, materials and construction, maintenance, traffic and safety, and so on. All papers have been prepared by authorities in their own fields. *National Research Council, Highway Research Board, Division of Engineering and Industrial Research, 2101 Constitution Avenue, Washington, D. C.—$2.25.*

FARM WIRING HANDBOOK is a 28-page illustrated booklet that constitutes a guide for planning electric wiring on farms. Such planning, properly carried out, makes for more efficient and convenient use of power. *General Electric Company, 1285 Boston Avenue, Bridgeport, Connecticut.—Gratis.*

FINCH FACSIMILE FIELD LABORATORY is an illustrated booklet describing facsimile transmission and reception, with particular attention to a mobile laboratory that is now being used for research in this particular branch of communications science. *Finch Telecommunications Inc., 1819 Broadway at Columbus Circle, New York, New York.—10 cents.*

88 YEARS is an 18-page illustrated pamphlet that outlines the history and present status of the Studebaker organization. For 88 years this manufacturing unit has been producing vehicles that have played a large part in the development of the United States. *Glenn Griswold Associates, Public Relations, 330 West 42nd Street, New York City.—Gratis.*

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SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

TO THE co-ordinated action of all categories of warships, in fleet operations, must now be added co-operation of and with the Air Force of the Navy. Aircraft go with the fleet and operate with it offensively and defensively. In our cover, an official U. S. Navy photograph, battleships and aircraft are shown in recent maneuvers.

OCTOBER • 1940

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OUR *Point* OF VIEW

MYTH? PART TRUTH?

AT LAST a way to put the Lost Atlantis tradition to a scientific test has been found. Readers will recall how Plato recorded a story, which in his time was already 8000 years old, that a vast land lying west of Gibraltar and containing a great empire, in a day and a night sank beneath the sea. The belief, therefore, that the rich cities of a civilization more advanced than our own lie today in all their arrested splendor burns bright in the souls of modern Atlantis cultists. Is that tradition entirely mythical?

Lying 12,000 feet beneath mid-Atlantic waters is the Atlantic Ridge, a vast submerged plateau which some Atlantean believers identify with the Lost Atlantis. Why couldn't this have sunk? Do not parts of the earth's crust rise and fall, as geologists commonly point out? Aside from the fact that few geologists believe large areas founder deeply, the unusual feature of the Atlantis tale is the sudden submergence it calls for. Geologists deny its possibility.

Within recent years, however, new evidence has come to light that may encourage the Atlanteans. Perhaps, instead of itself sinking, the Atlantic Ridge plateau was laid bare by a subsiding sea and later flooded again by a rising sea. The discovery of large submarine canyons far below present sea-level now leads some geologists to believe that these were excavated by rivers flowing on what then was dry land. To account for this apparent anomaly, they assume that a great deal more of the earth's water was locked up as glacial age ice than has previously been thought. One geologist, A. C. Veatch, estimates sea-level in glacial times at 12,000 feet below present sea-level. This fits in nicely with Atlantean tradition.

If the waters gradually withdrew during 50,000 years of the last glaciation, the Atlantic Ridge might for many millenia have had a population. Finally, as polar ice melted away, the seas would have risen and the area would have been submerged—not, however, overnight or even over a lifetime—something geologists refuse to accept. (Incidentally, the inhabitants could not have been able to distinguish the rising sea from a falling land.) A tradition of sinking would have started among those who departed the area, and before long the story would have picked up trimmings, most certain of which would be a submergence with dramatic suddenness, for this would be too good a supplied detail for man to forego.

Methods of surveying the sea-beds with previously unhoped-for precision, by employing the sonic depth finder in connection with remarkably exact methods of measuring horizontal distances with actual tapes (wires), have recently been developed and proved good. In many places such surveys reveal a thing that makes geologists raise their eyebrows—a complex pattern of typical land-surface, stream-erosion channels. And now Capt. Gilbert T. Rude, of the United States Coast and Geodetic Survey, in the *Proceedings of the United States Naval Institute* for August, proposes that such a survey of the Atlantic Ridge be made.

Capt. Rude does not propose this merely to test the Lost Atlantis tradition, for it would have other and greater values to science, but he does point out how it might tend to settle this old question. If a typical pattern of stream-erosion channels—in other words, valleys—were found covering the Ridge area, this would tend to favor the Atlantis hypothesis. If only typically smooth, unchanneled sea-bed topography were shown, Atlantis would look still more like pure myth than it already does to most scientists.

However, even if the eroded land-forms were found, the real essentials of the Atlantis hypothesis, as its mystical proponents prefer to have them—that is, the great "empire" and the civilization "superior" to those of our own times and all that kind of thing which mystics and occultists dearly love—would scarcely be given encouragement; unless perchance the dredges of the Survey were to haul up from over one mile beneath the surface a golden throne and some things we benighted moderns could not yet understand, perhaps an atomic energy machine.—*A. G. I.*

FEEDING FOREIGNERS

UNCLE SAM is being urged by some well-meaning but near-sighted citizens to feed and clothe the needy of European countries which are now under the domination of the German war machine. Should such a plan be put into effect, it would surely prolong the present conflict and might even be the instrumental factor in tipping the scales in favor of a Nazi victory.

At the present time, Germany is reported to be stripping the invaded countries of all available food supplies, which indicates the effectiveness of the British blockade. Regardless of any promises which might be made by Germany, food and clothing supplied to invaded countries undoubtedly would be seized by Germany as a matter of self-preservation. The fact must not be overlooked that should the present blockade continue to be effective, the obvious strain on the resources of Germany in feeding itself as well as the populace of conquered countries might bring about an early cessation of hostilities.

While we have every sympathy for the sufferings of the people of Europe, we should steel ourselves to the fact that to rob Great Britain of the effects of one of its most potent forces—the blockade—might be the means of bringing about a far greater catastrophe.

A large amount of money has been solicited from the people of the United States for the purpose of aiding the destitute of foreign countries. In fact, one organization publicizes the fact that it has available many millions of dollars. There are in the United States thousands of people who are in absolute need and worthy of every charitable consideration. Would it not be a good idea to use the funds collected for foreign assistance for the aid of our own countrymen who are unable to obtain the necessities of life from other sources?—*O. D. M.*

50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of October, 1890)

WAR BALLOONS—During the last sixteen or seventeen years, the Dutch government has been carrying on a more or less active war with certain tribes in Acheen, a district of Sumatra, the third largest island of the world, and with this view have dispatched a military ballooning contingent, under the direction of Mr. Percival Spencer, an English aeronaut, to Kota Rajah, the fortified capital of the unconquered regions, where it is proposed to establish a permanent balloon reconnoitering corps to watch and, if possible, circumvent the strategical movements of the enemy.

PACKAGE TRANSPORT—The portelectric system . . is intended for the transportation, not of passengers, but of mail and express matter only, at rates of speed approximating two miles per minute, the steel car being drawn along its confined path at this high rate by the pull of

numerous solenoids through which the track is laid, each coil exerting its power for a short time only as the car approaches it . . . The passage of the car completes the circuit between the upper and lower rails through th solenoid in advance of the car, and the car is thus pulled into the coil until it is midway through the coil, when the current is cut out and transferred to the next coil in advance.

TELESCOPE—The glass for one part of the great forty-inch objective of the new Southern California observatory has been received by the Clark Brothers, of Cambridgeport, Mass. . . . The telescope is to be mounted in an observatory upon Wilson Peak, of the Sierra Madre Mountains, 12 or 15 miles back of Los Angeles, Cal.

GUN POWER—The range and penetrating power of modern rifles are tremendous. The six-inch rifle will hurl its projectile through ten and a half inches of wrought iron a thousand yards from the muzzle. The eight-inch rifle will pierce sixteen and three-tenths inches of iron at the same distance. The ten-inch rifle that the rejuvenated *Miantonomoh* will carry will send its missile through twenty-one inches of iron a thousand yards away. The twelve-inch rifle, of which we are to have a supply in the future, will penetrate twenty-eight inches of iron at a range of three thousand feet.

METAL VALUE—The price of platinum has recently advanced very greatly, until now it is nearly equal in value to gold. In July, 1889, the price was $8 an ounce, six months ago it was $14, and at this writing it is $20 an ounce, while gold is quoted at $20.70 (*sic*). This rapid rise in the value of the metal is due to the steadily increasing demand from the manufacturers of electrical apparatus.

CHOLERA—Advices received from Tokio, via Yokohama and British Columbia, contain intelligence of the terrible outbreak of cholera which has taken place in Japan, by the ravages of which upward of 200 deaths were occurring daily.

ANCIENT ROSE—At Hildesheim, in Hanover, there is a celebrated rose bush, the oldest in the world. Charlemagne himself planted it more than a thousand years ago in commemoration of the embassy received from the caliph of the Thousand and One Nights, Haroun al Raschid.

EXHIBIT—The 59th annual exhibition of the American Institute opened, in this city, on October 1, and is now in progress . . . Among the photographic novelties is the slot machine for taking photographs. On sitting in position and dropping "a nickel in the slot" and executing some manipulations, a photograph of the sitter is passed out.

PRECIOUS—Uranium was unknown a century ago, but a lode has been found in a mine in Cornwall, England. It sells for $12,000 a ton.

SHIPS WITHIN SHIPS—A floating island made of steel 1,000 feet long, 300 feet wide, and drawing 26 feet of water — such is the type of ship as described by Sir Nathaniel Barnaby . . . Constructor Barnaby would load and unload his ship in midstream by lighters, and, instead of breaking their bulk, would take them aboard, hull and cargo, for his plan includes a clear sheet of water for them 'tween decks, a miniature harbor into which they may be floated at one port and floated off again at another. Once the lighter fleet containing the ship's cargo is properly arranged aboard, the floating basin can be pumped dry and all comfortably stowed for the voyage — the sea being let in again after the ocean has been crossed, and the cargo thus distributed in many bottoms floated ashore.

ADVERTISERS during the Fall season of 1890 included: Keuffel & Esser Co. (surveyor's instruments); L. S. Graves and Son (elevators); Armstrong Man'f'g Co. (stocks and dies); Hartford Steam Boiler Inspection and Insurance Co.; The Eastman Company (Kodaks); G. Gennert, (Montauk cameras); Rochester Machine Tool Works (stationary engines); Felt & Tarrant Mfg. Co. (Comptometers); Babcock & Wilcox Co. (steam boilers); Overman Wheel Co. (Victor bicycles); Smith Premier Typewriter Co.; Millers Falls Co. (saws); John A. Roebling's Sons (wire rope); The Eagle Bicycle Mfg. Co.; Seneca Falls Mfg. Co. (foot power machinery); Edison Lamp Co.; L. S. Starrett (micrometers); The American Bell Telephone Co.; The Pictet Artificial Ice Company; L. Manasse (magic lanterns); Ingersoll-Sergeant Rock Drill Co.; Rand Drill Co. How many of these names are familiar today or strike responsive chords in your memory?

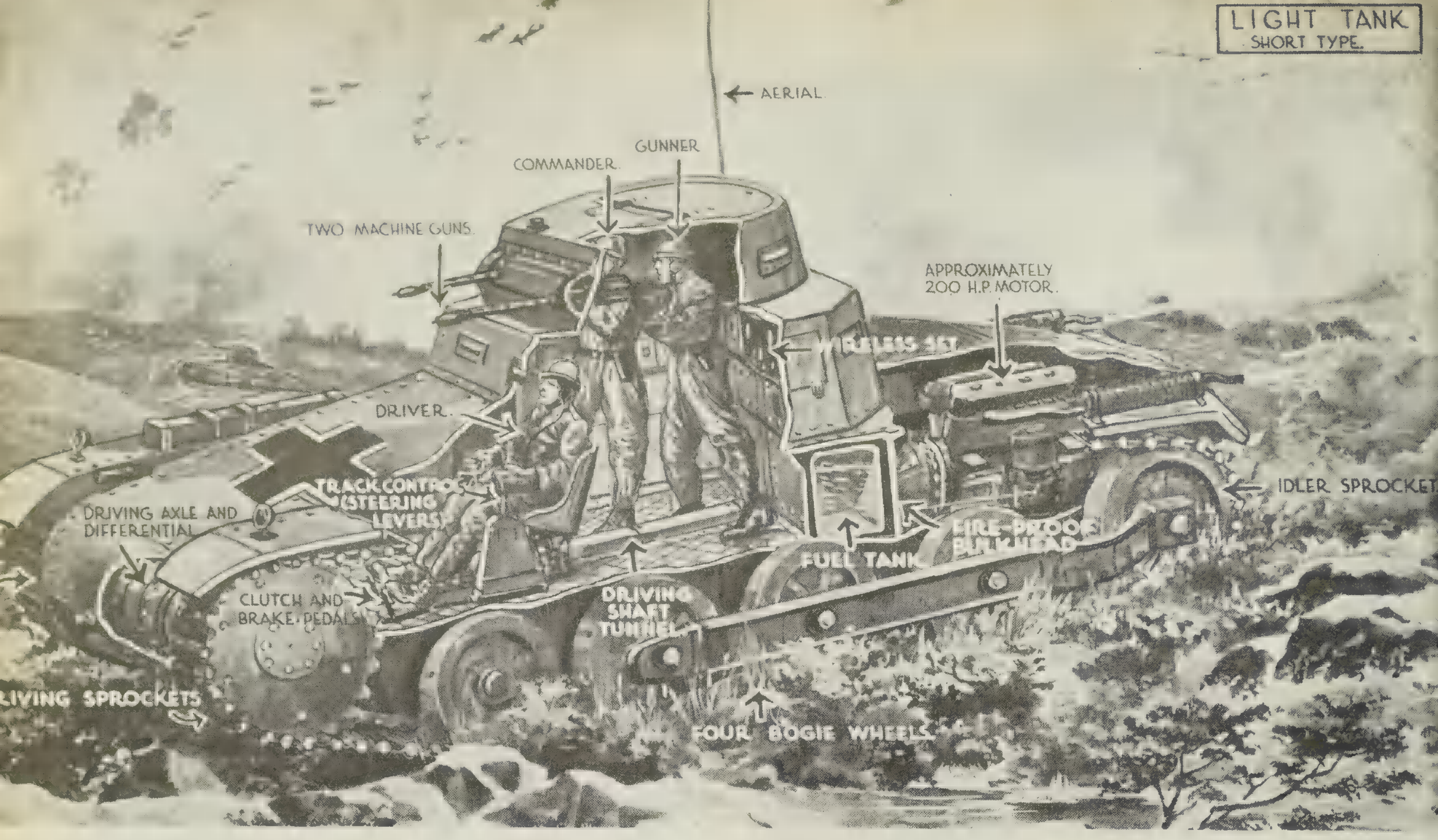
Courtesy

We want your telephone service to be good and quick and cheap. But there's more to it than that. We want it to be courteous too.

No matter what the occasion, there's always time for a cheery "please" and a pleasant word of thanks. That is the Bell System way. It is one of the fine traditions of the telephone business.

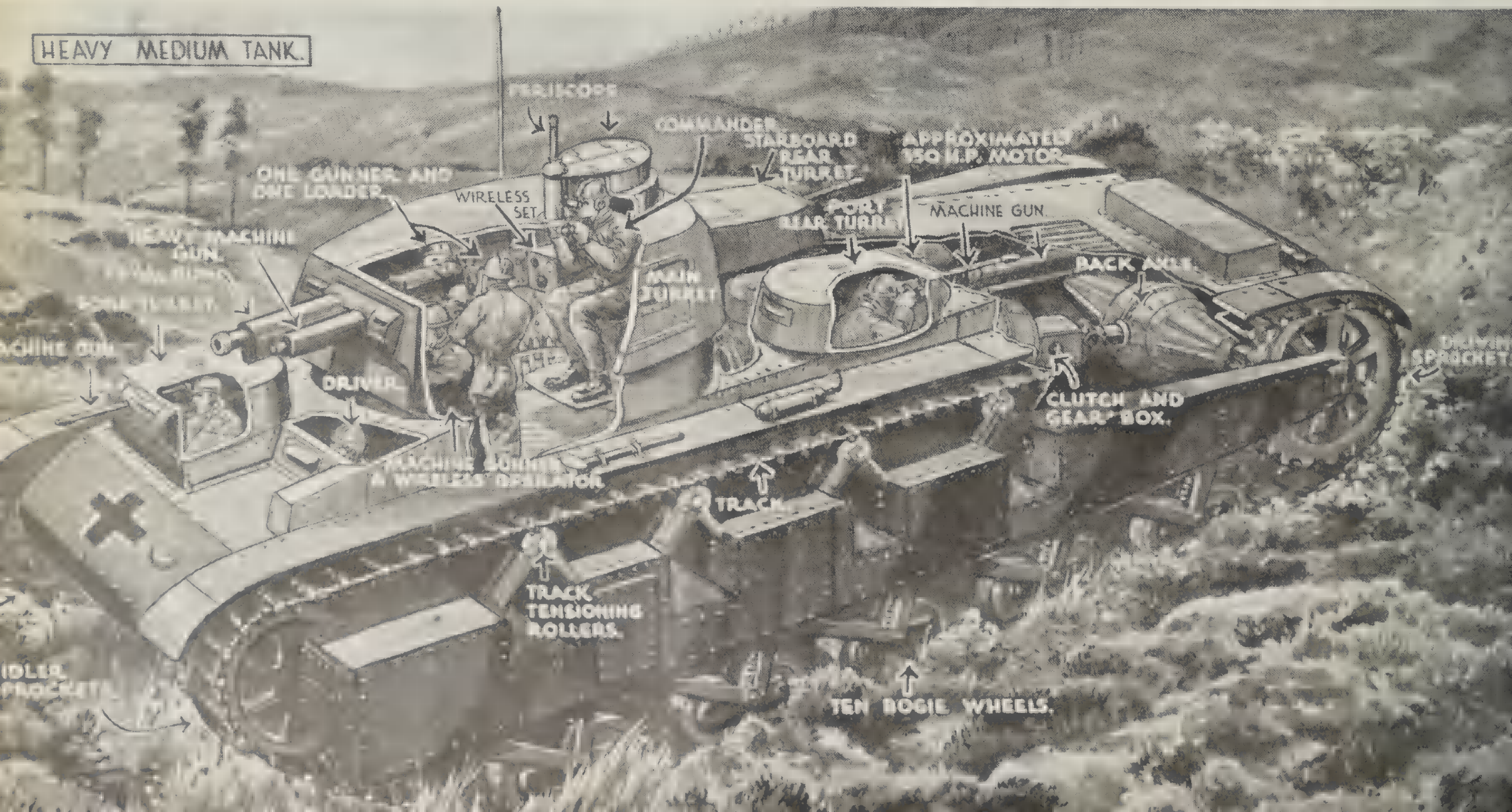
BELL TELEPHONE SYSTEM

PREPAREDNESS—THE BELL SYSTEM IS PREPARED TO DO ITS PART IN THE NATION'S PROGRAM OF NATIONAL DEFENSE



MECHANICAL SHOCK-TROOPS OF THE BLITZKRIEG

MODERN land warfare, as conceived by the Germans, puts the tank on the second line of offense, to follow the spearhead of the attack—the dive-bomber. Having built vast numbers of these mobile, light artillery units, the Nazis have been able to sweep irresistibly across several countries. Several types of tanks are employed, including the two shown here; a light tank, long type; a light medium type; and possibly larger types. The short, light tank, *above,* mounts machine guns, carries a crew of three, and has a road speed of perhaps 30 miles an hour. The long, light type mounts a machine gun and either 37-mm or standard anti-tank guns. The light medium tank is similar to the long, light type, but has a look-out hatch and heavier gun. The heavy medium, *below,* mounts a 75-mm gun in a turret, several machine guns, has a crew of seven. Drawings from *The Illustrated London News.*



96TH YEAR SCIENTIFIC AMERICAN OCTOBER 1940

BOMBERS PLUS BATTLESHIPS

Both Are Needed For Co-Ordinated Effort

A. B. VOSSELLER
Lieutenant Commander, U. S. Navy

When the editor of Scientific American requested this article, he suggested the title "Bombers *versus* Battleships." Since the days of General William Mitchell, of the U. S. Army Air Corps, controversy has raged upon this subject and many articles purporting to analyze the problem of bombs, or bombers, *versus* battleships have appeared. Events abroad have intensified interest in this question and it is, therefore, quite understandable that the editor should think his readers would be interested in the subject.

In the writer's opinion, however, no more dangerous argument bearing on national defense problems than this very question of bombers *versus* battleships has ever occurred. In the writer's view, it would be about as easy and conclusive to present a discussion upon the subject of brothers *versus* sisters or, to select an analogy closer to the question, infantry *versus* tanks, whereas the self-evident fact is that we need both. The real question which every public-spirited officer of the Army or Navy, or for that matter, every public-spirited civilian, is interested in, is the broad question of adequate national defense rather than any narrow question of the transient superiority of some particular arm over another arm of the national defense, and that under certain given conditions. Hence the title selected and used above.

There never has been any argument, to the best of the writer's knowledge, about the fact that a bomb, if it hits, will damage a battleship—or anything else which it may strike. There has been a great deal of discussion, some of it quite acrimonious, as to whether one bomb will sink a battleship and if not one bomb, then how many. That type of argument proves nothing, beclouds the issue so far as the uninformed are concerned, and is generally destructive to the best interests of our national defense.

NATIONAL DEFENSE

The fact of the matter is that a battleship, or any other warship, is a very strongly constructed vessel and the damage which will be sustained by a hit from an aerial bomb will be largely determined by the location of the hit and the particular circumstances prevailing at the time.

The whole controversy of bombers *versus* battleships is strongly reminiscent of similar controversies which took place years ago concerning the relative merits of battleships and destroyers, and likewise battleships against submarines. At that time the proponents of the battleship stoutly maintained that the battleships were superior to the destroyer and the submarine, each with its torpedo; and the proponents of the destroyer and submarine were equally as insistent that their pet weapon had rendered the battleship obsolete. It should have been obvious then, as it is to all thinking people today, that neither was "superior" to the other but that, as in the controversy of the battleship and the airplane, new and highly destructive weapons for use in naval warfare had been developed.

It is submitted as highly significant that there has never been any great controversy in the Navy itself over the relative value of the bomber and the battleship and that most of this controversy has been thrust upon the Navy by others. The flyers of our Navy are not only naval aviators; they are also seagoing naval officers who understand the inter-relationship between the various parts of the Navy and therefore would no more sacrifice battleships than they would the Navy's aviation.

This is believed to account, in large measure, for the eagerness with which aviation was seized upon as a tool by officers of our Navy, once its teething days were over and the future stature of aviation became apparent to the discerning. The result was that all phases of naval aviation were strongly pushed and highly developed with the further result, today, that U. S. naval aviation is preeminent in all its phases over every other air force in the world.

Development has many times seemed maddeningly slow to the officers of naval aviation, but, as we regard the status of things at present, we find that, slow though it may perhaps have been, it has nevertheless been sure and steady and certain. The U. S. Navy today finds itself with aircraft carriers so far ahead of any others in the world in operating technique, training of pilots, suitability of aircraft carried, and, most important, training with the Fleet, that there is no comparison possible. In the same way, the long-range patrol bombers of the U. S. Navy are incomparably better in every respect than those possessed by any other air force in the world.

We have now, and have long had, more planes of this type than any other air force and newer and

The opinions or assertions contained in this article are the private ones of the writer, and are not to be construed as official or reflecting the views of the Navy Department or naval service at large.

finer ones, embodying all the lessons from our wealth of experience in the past, are under manufacture and soon to be delivered. The dive bomber, which has demonstrated its frightful power so overwhelmingly in the hands of the German air force, was pioneered, developed, and perfected by the U. S. Navy and today only the Germans and U. S. naval aviation have real dive bombers. All our battleships and cruisers carry aircraft to be launched by catapults from their parent vessels and these airplanes also have no peer in any air force in the world. The pilots who fly them have been especially trained and indoctrinated to work with their parent vessels and it is merely a matter of routine in the Fleet to use these aircraft for scouting, submarine searching, and spotting of gunfire.

Photographs: Official, U. S. Navy

Hidden above a layer of clouds and catching only occasional glimpses

It will be seen from the above brief summary, therefore, that technically, and in the development and adaptation to naval use of new ideas, naval aviation has led the world. Important and encouraging though this progressiveness and progress are, they are by no means the whole story, nor even the most important part.

The organization of the German air force has recently been the subject for much argument and speculation. Whether, however, Germany has in fact a separate air force, whether the air force operates under the army or vice versa, the real lesson that we should draw from the German operations in Europe is the extraordinary co-operation which has been exhibited between air and ground forces, no matter how achieved. Destruction wrought by the German air force has been terrible to contemplate. It is submitted, however, that such destruction, unco-ordinated with advance of the ground forces, would not have rearranged the map of Europe as we find it today.

It is in this co-ordination between all arms and branches of German national defense that the *Luftwaffe* has displayed its outstanding qualities and it is in these same characteristics that the U. S. Navy, including its naval aviation arm, is likewise outstanding. For years, naval aviation has been going to sea with the Fleet, daily, monthly, year in and year out; in each year for at least the last 15, naval aviation has played a large, and many times predominant, part in the annual Fleet maneuvers.

Sky-going ships of our aerial Navy. These patrol bombers have wide range and carry enough bombs to start and finish a battle-line job

Most of the officers and men now serving in naval aviation have served in all its branches: battleship- and cruiser-based, patrol plane and carrier squadrons. In their years aboard battleships and cruisers, they have taken their turn at watch-standing and know as well as their comrades on general service duty what the mission of the surface vessel is and how that mission should be carried out. Aboard the carriers they have become thoroughly indoctrinated in the methods of co-ordinating and delivering the group air attack on both enemy surface vessels and aircraft and they realize full well that co-ordination, timing, and teamwork are the essence of any joint effort.

In this connection it is of interest to mention that all of the non-flying line officers of the Navy are required to be familiar with the theory and practice of aviation and must periodically, before promotion, undergo examination in this as well as other professional subjects. These non-flying line officers serving in battleships, aircraft carriers, cruisers, and tenders are, of course, continually working with the aviation personnel attached to these ships and they in turn learn

the ground, a utility squadron flies on toward its objective

tion an abstract argument. The problem facing the Navy today is to build, upon the excellent nucleus we now have, the expanded naval aviation of tomorrow, maintaining the co-ordination we now possess so that when and if our Navy goes into battle, all its components will be there in adequate number and all will be working together in the most efficient way to achieve the final result—total defeat of the enemy.

• • •

in this practical way the capabilities and limitations of aviation.

Those who serve in the patrol wing understand that, although they carry heavy loads of bombs, their primary mission is to act as the Navy's long-range, high speed air cruisers until the enemy is located and his intentions diagnosed. They understand the reason, too, which is that the mission of our Navy in the next war, as it has been in the past, will be to seek out and destroy the enemy completely and finally, using all the force at our command on the surface as well as above and below it. The fact that the British were able to evacuate some 300,000 men from Dunkerque to England under the very nose of overwhelming German air power has not been lost on these men and they want no sole dependence on air power which might allow such a thing, in reverse, to happen on our shores.

It is believed to be generally recognized now that one of the greatest and most far-sighted public services which was ever rendered the United States was the determined effort and successful fight waged by the high command of the Navy in preventing the formation of a unified air service to include naval aviation. We have before us several excellent, if also tragic, examples of the difficulties which the United States might now face had our present course of action not been followed. The principal one of these is, of course, that of Britain, wherein the Royal Air Force was set up as a third arm of Britain's defense with the result that the Fleet Air Arm cannot now afford the British Navy the strong air support which that Navy so badly needs. The final history of the present war will record the tragic loss of many British lives because of the slip-ups and misunderstandings inevitable under any such system of divided control.

The above record of progress and accomplishment has been set down so that the reader may understand why we in the Navy consider the "bomber *versus* battleship" ques-

AIRCRAFT versus WARSHIPS

ALTHOUGH Mr. Charles Edison, when Secretary of the Navy some months ago, stated that airplanes have a temporary advantage over battleships, it is apparent that protective measures for the ships were already known. An editorial in a recent issue of *The Engineer* (London) discusses this matter in detail and states the protection necessary. We quote below a pertinent part of that editorial.

"We have now had experience of many months of war, and it is not unreasonable to inquire whether this question can yet be answered. It is, of course, less a single question than a group covered by a single title, for there are ships and ships. If we consider first the vitally important question of the battleship, it may be said at once that we do know a great deal more than we did. It is true that we knew beforehand that the battleship of today

Torpedo planes, dive bombers, and cruisers—they're all part of the team. Properly co-ordinated, they make a powerful defensive arm

was strongly protected by deck armor and was difficult to hit. To penetrate armor requires high striking velocity, and this, in turn, calls for a high altitude of attack on the part of the aircraft, though the greater this height the less chance of hitting. Hence the two chief attack requisites were, and still are, mutually conflicting. Nor can modern developments materially affect this position.

"The bombs now in use are better streamlined than in the last war, and they are heavier, but even so the velocity they acquire during descent remains much where it was. Even were air resistance entirely removed, the vertical velocity attained from any height could not exceed that corresponding to a vacuum trajectory, which from 20,000 feet is but 1100 feet per second; in practice it would, of course, be materially less, and even were the height of release pushed up to 30,000 feet, or even 40,000 feet, the velocity would be but little greater since, in the neighborhood of the speed of sound, the rapid rise in air resistance cushions further increase. Nor could an attack during a dive from high altitude materially alter the situation, since an initial downward speed of even 400 feet per second would hardly affect the velocity at sea level. To fire the bomb downward fast enough to increase the ultimate speed would, for a bomb of adequate size, require an aircraft gun of such dimensions and weight as to be outside the field of possibility; whilst any form of rocket-bomb is likely to present great practical difficulties. Hence, if the armored deck can keep out a bomb which arrives with a striking velocity of 1100 feet per second, it can be said to have the latter beaten. And this, our present war experience has shown it can do.

"ONE at least of our battleships has been hit by such a bomb and the armored deck has proved to be just that protection which our naval architect said it would be. Hence the contest between the battleship and the bomb has largely ceased to be the doubtful factor that it was. It is true that this leaves out of account the 'near-miss,' the bomb which explodes under water close to the ship, but this should be regarded rather as an attack by a mine or aerial torpedo than by a bomb. The essence of a bomb is to cause such an explosion inside a ship as will damage the vital machinery below the armored deck, or even hole the ship from the inside; whereas the object of the mine is to blow in the side or bottom of the ship by means of the intense pressure wave created in the water by its detonation. Hence the 'near-miss' must be looked upon as a mining attack and any battleship adequately protected against mine and torpedo may be looked on as protected also against the 'near-miss.' "

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HELLDIVERS

Describing the Technique of Dive-Bombing, Conceived for United States Naval Use

JAMES L. H. PECK

Author of "Armies With Wings"

YOU are at the controls of a rapidly climbing dive-bomber—the most feared, most spectacular of warplanes—miles out over the sea, leading a three-plane "V" formation in search of an enemy cruiser. You level off at 8000 feet. A moment later, you spot the warship off the port wingtip; you lift the microphone and radio a terse command to your "wing men." The one who is flying behind and to your right, slides over neatly and settles into place behind the left, or Number 2 "wing man." Now the dive-bombers are in left èchelon, or step formation—an excellent arrangement for the attack.

You swing in a wide curve to the left; it is early afternoon and you want to keep the formation between the sun and the enemy so that the ship's anti-aircraft gunners will find difficulty in spotting you. Peering down at the dark sea to ascertain wind direction, to check the drift of smoke from the ship's funnels, you note that the wave crests are rolling in a direction almost parallel to the cruiser's course. Good. From the angle you are contemplating attack, the wind's effect will tend to compensate for the common tendency to bomb "over," or beyond the craft. There will be just one attack; each plane is carrying an 1100-pound armored demolition bomb; each must count.

A succession of staccato explosions just reach you from below when they are duplicated a short distance above, and behind the formation. You make a sharp tack, then another in the opposite direction; then you lead the formation down about 200 feet and make another tack. Shrapnel, accompanied by blossoming, black puffs, burst where the planes were a few seconds ago. Almost over the vessel now; you slide to the left just a bit. The ship is turning, but it will be just right by the time the bombers drop down.

Another terse radio command. You roll the speedy monoplane over on its back, "peeling off" the echelon and heading down in one big hurry. You are shooting down, a bit over on your back—upside down. Now the plane is vertical; you're streaking down an invisible roller-coaster with the sun at the top. The huge engine down ahead is throttled back, but not all the way, because the carbureter would flood and the engine would cool off too quickly. Down at the bottom you're going to need all the engine you have to get up and away. You have trimmed the bomber's elevator tabs so that the ship is slightly nose-heavy; it dives better so. Your eye is glued to the telescope sight, and you watch the cruiser's gray-looking deck and superstructure rush up toward you.

THE sea grows bluer. Guns, turrets, deck gear, and the scrambling crew become larger and more distinct, more detailed. Machine guns swing in the direction of your plane, you are literally flying down the gun barrels. But the sun is with you, protecting you. Your left hand darts to the bomb release toggle. You bring the nose up a trifle, just before the toggle is pulled. If the ship were on its back or perfectly vertical at the time of release, the bomb would take a part of the propeller along as it dropped away.

Now! You can feel it as the bomber is freed from its half-ton burden. You ease back on the control stick, and ease the throttle open. Ease is definitely the word: You pull out of the streaking dive in such a manner as to make it

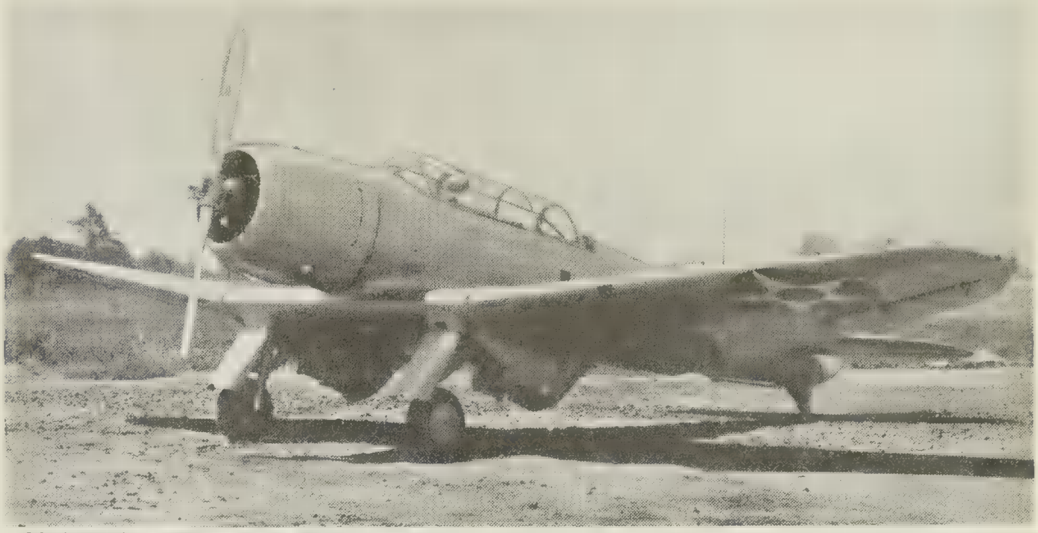
easy on both the plane and yourself. A weighting force crushes you down against the seat, but there is no blanking-out of vision because the pull-out was gradual. Momentum of the dive, and the power of the engine, boost the dive-bomber up the other side of the invisible roller-coaster at a terrific rate.

You look back over the tail at streaking tracers from the vessel's machine guns, but you've much too much speed. Your Number 2 man comes out of his dive just above the pall of smoke from your bomb. There's a flash and mushroom of evil smoke as his bomb hits the ship's taffrail. Then the Number 3 pilot lets go. Just aft of the stern, you see a huge billow of white foam, then a geyser and an expanding ring of churning water. Tiny splashes are everywhere, caused by the rain of debris.

You throttle down so that the "wing men" can join up. But the formation is just a loose string, a follow-the-leader affair. The cruiser lists badly to starboard. Your gunner is watching through glasses from the enclosed rear cockpit. Men are scurrying about the deck of the cruiser, manning the boats. The ship is going down by the stern, slowly but steadily.

Again you pick up the microphone; but this time your message has to do with saving life, not the taking. You report the success and completion of your mission, and give the sinking vessel's position so that one of your destroyers can pick up the survivors.

That is dive-bombing — the method by which more than a few ships have been sent to Davy Jones' Locker during World War II; the method by which Nazi fliers soften land defenses as they form the spearhead of the swarming *blitzkrieg* assault. This new tactical employment of the dive bomber against airdromes, fortifications and gun emplacements, troop concentrations, supply depots, and other objectives in the British back areas is designed to supplement artillery fire. Hitler's *Sturzkampfflugzeug* — literally meaning dive-fighter, and popularly known and feared as "Stuka"—wreaked havoc in Spain, grounded the ill-fated Polish Air Force in just three days, helped make central Norway untenable for the Allies, was a prime factor in bringing about the capitulation of France.



Photographs: Official, U. S. Navy

Newest of our dive-bombers is this sensational Northrop XBT-1

Douglas TBD-1's, of Torpedo Squadron Five, "on the way down" in formation

Most widely known "Stuka" is the gull-winged Junkers JU-87 monoplane which is powered by a 1000-horsepower Junkers Diesel motor, and has a top speed of 242 miles per hour. The outstanding features of this four-year-old, all-metal, dive-bomber are its wing flaps and slots and deflector fork. The flaps comprise four hinged surfaces on the wing's trailing edge which may be lowered to increase the air's drag, thereby slowing diving speed from 430 miles per hour to just a few miles per hour more than the ship's top speed in level flight. Used in combination with these "diving brakes" are two slots or foils in the leading edge of the Stuka's wing—all of which make for bombing accuracy, in that the craft can dive within a few hundred feet of the ground to release its deadly cargo. The "Stuka's" deflector fork is the bomb rack gadget which lowers the 1100- or 550-pound bomb so that it will clear the arc of the propeller blades when released. The bomb is carried snuggled up against the center section of the wing to diminish air resistance. When the pilot makes ready to dive, the rack is extended. Additional firepower consists of four 110-pound bombs carried in wing racks, and three .312 caliber Rheinmettal - Borsig machine guns; two in the wings and one

Official photograph, U. S. Navy

Grumman mid-wing fighter "peeling off" into a dive. "Peeling off" increases accuracy, as pilot can keep target in sight; when nosing over into a dive, motor and cowl hide target until ship is at a steep angle

for the rear gunner to ward off back-biters.

Closely resembling the Junkers plane is the B & V Hamburger 137—an all - metal, single - seater having the same up-swept wing and pointed nose. The Henschel 123 is a stubby biplane powered by a radial air-cooled engine; it carries the same armament and bomb load as the more widely known Junkers. All three prototypes were originally classified as attack planes or *Schlachtflugzeug*, and they engage in attack-plane tactics as well as dive bombing. The latter are employed against more or less isolated objectives whose destruction calls for extreme accuracy. When strafing enemy troops, however, the attack-plane tactics demand low-flying assaults in which the "Stukas" do not dive steeply, but maneuver on level keel.

Machine-gun fire from craft flying at tree-top altitude in horizontal attitude describes a grazing, creeping barrage, while that from planes in a steep dive is necessarily limited in its forward travel. The level assault offers more protection, in that hedge-hopping "Stukas" are within sight and range of ground machine-gunners —larger anti-aircraft guns are useless against planes flying lower than 100 feet—for the shortest possible time. When diving at a steep angle, they may be seen and fired upon as they are on the way down and, necessarily, on the way up following the pull-out. Low-flying craft are difficult to perceive from higher altitudes, and this offers some protection against enemy pursuit planes. "Stukas" operate in three-plane units in both diving and level-flying assaults.

Because of the sensational success of both dive and attack tactics in World War II, it would seem that these are new applications. But Germany developed an attack plane —the armored, all-metal Junkers-Fokker, carrying three machine guns and some 200 pounds of bombs—early in 1917; and the United States conceived the dive-bomber, primarily for naval use, just ten years later. The famous Martin dive-bombers and Curtiss "Helldivers," with their characteristic, back-swept upper wings, became the pride of the Naval Air Service, and the Curtiss 02C's did yeoman service with the Marines in Nicaragua.

TODAY, the all-metal Curtiss SBC-4 biplanes form a very important part of our Flying Fleet, together with the Douglas SB2U and Northrop XBT-1 monoplanes. The former two are known as scout-bombers; like their brothers of the Army, the reconnaissance bombers, once they spot the enemy, they stop scouting and commence bombing. The Northrop, newest of the Navy's dive craft, is a two-seater and strictly a dive-bomber. There can be little doubt that, after the most convincing demonstration abroad, Uncle Sam will provide faster and better dive-bombers aplenty for U. S. defense. The "Helldivers" have come of age.

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SMOKELESS, FLASHLESS

New U. S. Powders Don't Betray Gun Positions

A SUPERIOR quality of propellant powder will be manufactured at new powder plants which are to be built by the government near Louisville, Kentucky, and operated by the du Pont Company. When these plants are ready, the nation's present output will be tripled, these new ones making something like 200,000 pounds per day.

The new powder is not only smokeless but also flashless so that when a gun is fired at night only a dull red glow may be seen a short distance from the gun. It is said even the noise will be decreased.

Sikorsky's Helicopter

ALEXANDER KLEMIN
Aviation Editor, Scientific American.
In charge, Daniel Guggenheim School of Aeronautics, New York University.

In our September issue we reported on Igor Sikorsky's views regarding the utility of the helicopter in military operation. With these views we agree thoroughly. But the pioneer inventor does not merely hold views; he builds aircraft to substantiate them. Witness the VS-300 helicopter, recently constructed and tested in the plant of Vought-Sikorsky Aircraft.

The new helicopter, as indicated in our photograph, is equipped with a single lifting rotor, three-bladed and 28 feet in diameter. There is considerable advantage in a single rotor, because the maximum lifting and forward flight efficiency are secured thereby, and because the overall dimensions are kept down to a minimum. Moreover, with the engine placed immediately below the rotor hub, the transmission system is reduced to its barest elements. With a single lifting airscrew, there is, however, a turning moment to take care of; the fuselage and its occupants would otherwise spin around dizzily in space. This difficulty is met by placing a small auxiliary airscrew at the very tail of the helicopter, rotating in a plane which is parallel to the plane of symmetry of the helicopter. With this plane of rotation, the auxiliary airscrew provides lateral thrust and the turning moment of this thrust counteracts the torque of the main rotor. When the pitch of this auxiliary airscrew is varied, its thrust is varied. Hence rudder action is provided.

The reader will note that there are two other auxiliary airscrews, mounted on outriggers from the tail end of the main fuselage. The pitch of these screws can also be varied at the will of the pilot. If their pitch is varied simultaneously they give longitudinal control; that is, control in pitching the craft up or down. If the pitch of the two outboard screws is varied differentially, they give lateral control like the ailerons of an airplane.

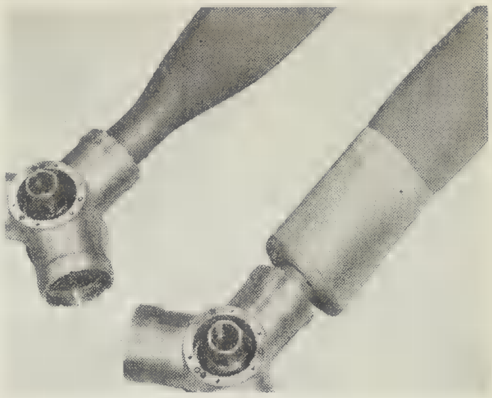
Thus the Sikorsky helicopter has control about all three axes, (which is an essential of all aircraft). Since the controls are engine driven they are operable when the machine is hovering, while ordinary movable control surfaces are operative only when the aircraft has forward velocity.

To secure vertical ascent it is only necessary to give the blades of the main rotor a fairly large positive pitch. While the machine has not yet risen to very high altitudes, the photograph indicates that ascent has been achieved. Forward flight is achieved by simply inclining the machine forward—that is, nose down—using the elevator airscrews for the purpose. Thus the thrust of the main rotor has a forward component which serves to accelerate the machine in a horizontal direction. As a matter of fact, the helicopter can go forward, backward or sidewise.

In case of engine failure, the pitch of the main rotor will automatically decrease so that vertical or gliding descent at a steep angle will become possible just as with an autogiro. The auxiliary screws remain in the same mechanical connection with the main screw whether power is off or on. Therefore the auxiliary screws remain operative as controls even when the engine is dead.

We congratulate Mr. Sikorsky on an elegant solution of the helicopter problem, and await further progress with real expectations.

Igor Sikorsky flying his helicopter



Conventional propeller shank, and shank with cuff (see below)

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PROPELLER CUFFS

One of our photographs shows, in its upper left corner, a conventional type of Curtiss Electric Controllable Pitch propeller with the blade shank exposed. At the lower right the blade shank is covered by a so-called "cuff." The cuff, of sheet aluminum alloy, continues the airfoil section of the blade, improves the streamlining and hence the efficiency of the propeller. Moreover, the thrust of the propeller is now distributed more closely to its center so that air is driven backward forcibly to the inner portions of the engine. Cooling is improved thereby. The sheet aluminum cover is easily removed and serviced, and we should not be surprised to see the use of cuffs become widespread.—*A. K.*

Geriatrics

The Newest Medical Specialty Deals with the Aging, Now that the Elderly Increase

BARCLAY MOON NEWMAN

WITH surprising suddenness, a new division of medicine has appeared—geriatrics—to help oldsters grow older, toward maximum longevity. The name was coined long ago, from *ger*—indicating old age, and *iatrics* meaning therapy. But, until a year or two ago, the specialty was little more than name.

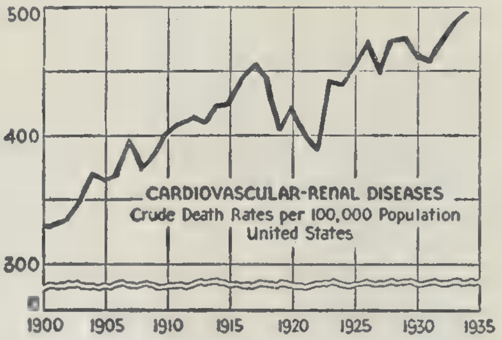
The aged we have always had with us. Why this sudden great interest? We have only to look about us—to see more individuals than ever before in the upper age brackets.

Greater than ever in world history are the odds in favor of our reaching advanced age. In Rome during the early Christian era, life expectation at birth was probably only 20 to 25 years. In certain European cities of two centuries ago, the newborn could expect to live 25 to 35 years. In the United States, just after the Revolutionary War, the expectation of life at birth was 30 to 35 years; in 1900, 50 years; today, white male babies can look forward to 60 and female to 63 years. The increase in expectation of life, at birth, since 1900, slightly surpasses the increase during the previous 100 years. By 1960, a newborn boy of this country may expect to live 75 and a girl 80 years.

There has been no observable increase, however, in the maximum length of life attainable by the most longevous man or woman. Persons surviving to advanced ages do not live longer than formerly. In fact, it is believed that those who, in 1890, reached three score and ten could expect more years than men and women who today are entering their eighth decade.

Only the average duration of life has been increased. Thus, in 1890, 72 percent of U. S. boy babies attained the age of ten; now more than 91 percent do. The early dangerous years are more often survived, and so the average age at death has gone up. Medical discoveries and their wide application, public health measures, improved nutrition, the elevated standard of living, and education, deserve the credit. The chief successes have been over microbic diseases—smallpox, bubonic plague, yellow fever, typhoid, diphtheria, tuberculosis. And newer nutritional discoveries may right now be in the midst of adding another 10 percent to the present average age at death.

In the meantime, the birth rate has been declining. By 1950, according to some calculations, our population will have become stationary, with the number of births equaling the number of deaths.



An effect largely of aging population is the upward trend of the curve: more people live long

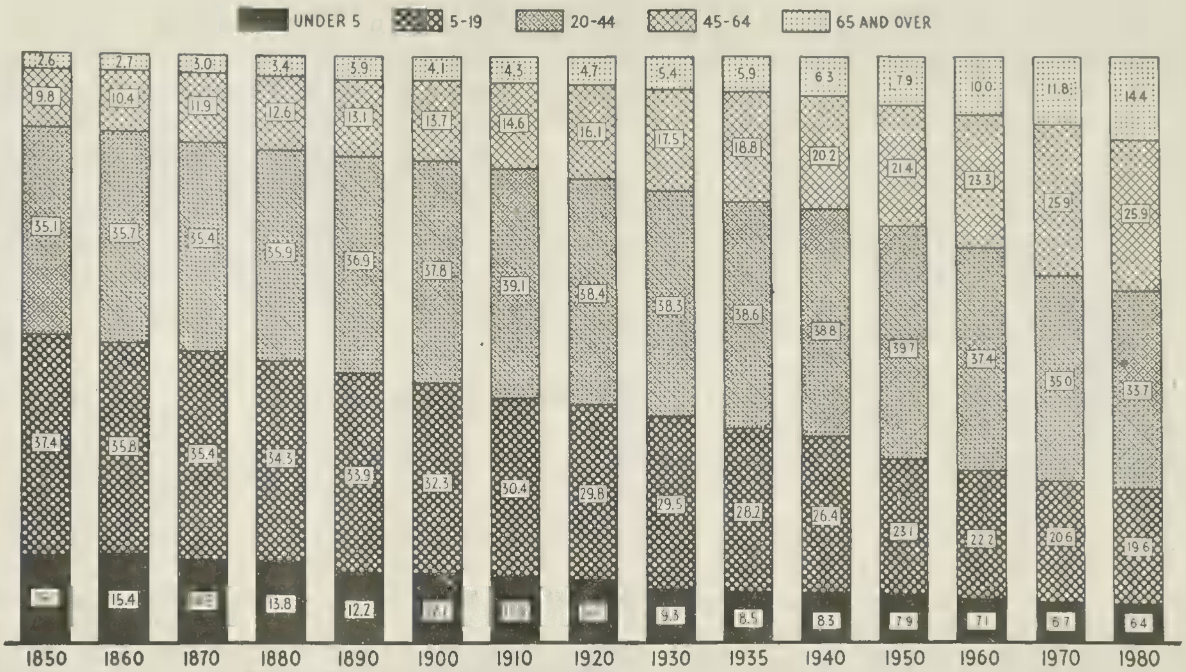
Declining birth rate and declining mortality rates for infancy, childhood, adolescence, and early adult life co-operate to yield an aging population. A century ago, youngsters under 20 made up half our population. Today only a third of U. S. individuals are in this group. A century ago, less than three percent of the population were elderly; that is, 65 and older. This percentage has already been doubled. Within another half century, men and women past 65 will make up more than 15 percent of the total population. More striking, however, is the fact that about 27 percent of us are today already 45 and older. In 1980, more than 40 percent of U. S. persons—infants to oldsters—will be 45 at the youngest. In another ten years (1950), the elderly (those past 64) will be as numerous as children under five years of age—the percentage of each in the total population will be about eight. The geriatrician will have as many patients as the pediatrician.

Pensions, old age "economic" schemes, and old age pressure groups have come to the fore, and doctors, like the rest of us, are awakening to the results of the crowding of the higher age brackets. The social and economic results are going to be enormous. Business and its advertisers must take into account the aging of the "average" consumer, who will have different tastes, interests, attitudes, habits, pleasures — and, above all, probably, increased conservatism. The dependent oldster is replacing the dependent youngster.

The average doctor notes not only that his average patient is older but also that the number of aged patients has increased. Old age is commonly said to begin at 65. However, many individuals are really younger at 75 than the average person is at 55 to 60. Time is a poor indicator of degree of senescence.

THE geriatrician does not find new diseases appearing after a certain age. The elderly have practically all the diseases of youth, but none additional. At certain ages, however, certain disorders are more common. The so-called degenerative disorders—especially of the circulatory system, the kidneys, and the brain—are less frequent in youth, more frequent in the upper age brackets. Sexual decline sets in usually during the middle years, if not before, so is not a problem for the geriatrician alone.

Heart disease takes its greatest toll during the fifth decade, and then declines in relative importance—though still very important —as far as geriatrics is concerned. Arteriosclerosis, found even in babies, is almost universally present in oldsters. Chronic high blood pressure becomes more and more common as years are accumulated. The kidneys increasingly are sources of ills as the decades pass. Heart, blood vessels, and kidney pathologies carry off two thirds of those dying between the ages of 80 to 89. Cancer, also found even in babies, is most common in later years. For white males, cancer reaches its mortality peak between the ages of 60 and 69, but during the next ten years is almost as im-



Illustrations courtesy Metropolitan Life Insurance Company

What medicine, public health measures, improved nutrition, and better education are doing to the age composition of our population. 1850-1930 are from census data, 1940-1980, estimated by Thompson and Whelpton

portant a cause of death. Among women, cancer is most prevalent from 50 to 59, but during the next 20 years the mortality remains high—second only to mortality from heart, blood vessel, kidney diseases. The mortality hazard of tuberculosis attains one peak in the middle twenties, and a second peak in old age. After 60, the tuberculosis death rate rises sharply, the aged having a lower resistance to this disease than the middle-aged.

The geriatrician, then, must be especially expert along specific lines. Furthermore, in advanced age, though there are no new disorders, the same disease usually runs a course markedly different from that followed in earlier decades. The tissues and organs have changed with time—some say because of time, but nobody can prove this speculation. The reaction of the old body is different, and so are the symptoms and the treatment. Fever typically present in the diseased person of lesser years may often be absent; in lobar pneumonia, the patient may stage a quiet, fadeout without fever. Appendicitis simulates mere intestinal obstruction.

Generally, in the old, there has been loss of weight and height. The fat depots beneath the skin, as of cheeks and temples, are much reduced. The skin itself is, as we all know, markedly altered: more pigmented, drier, rougher, wrinkled of course—though the degree of wrinkling is not a good indication of age. The sweat glands and oil glands are wasted. The muscles are deteriorating, perhaps undergoing fatty degeneration. The heart is enlarged, and has deposits of abnormal substances, as do the blood vessels, now much less elastic. Lung capacity is much diminished.

The bones have become somewhat porous and fragile from loss of calcium and phosphate and from gain of organic matter. There is less cartilage. The spinal curves are accentuated.

Digestive secretions are less in quantity and potency. The stomach, for example, is much less efficient, the gastric juice having a diminished content of hydrochloric acid. The alimentary tract is liable to bulging and the motility of its muscular walls seems to be weaker.

The liver, kidneys, spleen, pancreas, and brain are smaller and firmer, and their active cells have been extensively replaced with relatively inert fibrous tissue and fatty or other growths. Nerve cells of brain and spinal cord have accumulated mysterious granules, called waste materials by some investigators. Tonsils and lymph nodes are extremely shrunken, and the enigmatic thymus gland, too. The acid-alkali balance is readily upset and more slowly returns to the normal condition when disturbed, as by toxic substances. The lower extremities are less sensitive to vibrations. Sense of balance is impaired. In fact, as a general phenomenon, sensation throughout the body is impaired—"the organs suffer in silence," as one geriatrician puts it. Even traveling gallstones, excruciatingly painful in more youthful days, may in the elderly pass painlessly down the duct from the gallbladder. Youth's elasticity and resilience have sagged.

SUCH changes encountered in younger patients would be called pathological. The geriatrician, rightly or wrongly, must nowadays regard them as normal or "physiological." He must not let these common or characteristic changes obscure diagnosis of outright—more serious or more rapidly acting—disease, for the time being, at least; senescence not being called disease. To recognize disorder in the aged, the geriatrician must first be familiar with the moving picture of that which is termed "orderly progression of changes incidental to living long." It is difficult to know what is normal or orderly when most of the body is sinking into disorder; practically, the "normal" is the run-of-the-mine, or commonly observed, degeneration. The geriatrician's task is all the more confusing when he encounters the stalwarts of 80 or even 90 who are evidentally old but still hale and hearty — with good brains, hearts, livers, and stomachs. These stalwarts are either abnormal or supernormal! Their secrets the future may elucidate.

Treatment in geriatrics is as specialized and difficult as diagnosis. A severe disease frequently offers only mild symptoms until there is sudden collapse and death. Reaction to drugs is greatly altered; they are absorbed slowly, and often fail to give their familiar results. Heart stimulants may not stimulate, and sedatives may excite, usually do. And the drug's effect today may be changed tomorrow. Long stays in bed are unsafe; pneumonia or suddenly increased heart weakness makes insidious attacks.

On the other hand, the aged body has astonishing powers. Contrary to popular belief, the aged endure surgery better than many youngsters. It is often stated that the wounds of the aged heal slowly. Wounds in the adult of any age heal more slowly than wounds in the child. After the middle years, there is no perceptible retardation.

Diet is important. The vitamins of liver, especially the different vitamins B, have taken on increased importance for the geria-

trician; many of his patients are deficient in these. Out of fear of food, many old men and women indulge in harmful food fads. Still less fat should be eaten, and much fattening food avoided. The lightweight wins the battle of the century. Discoveries on the way may amazingly add to the life expectation after 65.

The geriatrician points out that the psychology of the aged is of immense importance. Indeed, physicians are more and more impressed by the theory that the lifelong outlook has major effects on the body. The chief cause of early death—before one's actually allotted span is accomplished—is surely the phrase "three score and ten." This phrase, the geriatrician knows, should be replaced by one indicating the real span of life. Man possibly is endowed with a life span of more than 100 years—how much more, even the geriatrician with his rapidly increasing wisdom does not know. But this new specialist, in an apparently discouragingly difficult field, is encouraged to find out—by keeping his patients well, if he can, well past the century mark. In the meantime, the basic bio-sciences proceed with the still unavailing search for secrets of rejuvenation. But of rejuvenation, the geriatrician can take no note; there is today no such thing for man or woman. Tomorrow?

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STEADILY BETTER

Three Decades of Science and Child Mortality

STRIKINGLY presented in the curves of the accompanying figure, from the *Statistical Bulletin* of the Metropolitan Life Insurance Company, are figures which show what three decades of scientific research has enabled medicine and public health to have done to cramp the style of a variety of prominent disease germs. Encouraging are these accomplishments, especially since intensification of the same efforts are expected to continue their improvement.

The curves are not based on the general average of the child population but on white children insured in the Metropolitan. The children insured distinctly are not those of a favored class; they are the children of an urban, wage-earning group who take out small industrial policies — say, $250 — and pay the premiums at the rate of a few cents a week. Figures for the general population would, however, not show much variation.

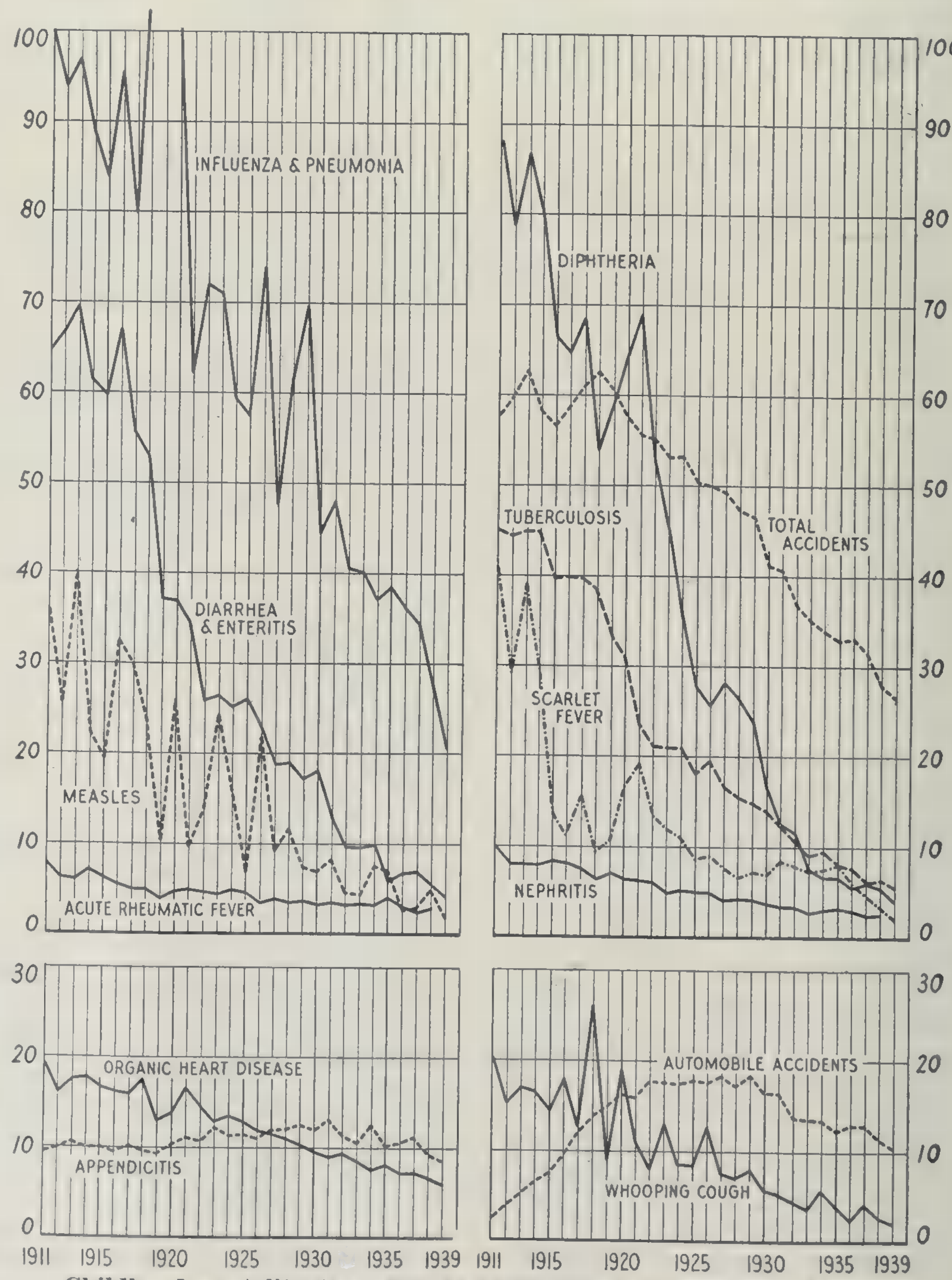
ROTO

New Cancer Treatment Method By X-Rays

AN improved method of using X-rays in the treatment of cancer hidden inside the body has been devised by Dr. S. J. Hawley, Roentgenologist at the Geisinger Memorial Hospital, Danville, Pennsylvania, and is used with modern Westinghouse X-ray apparatus.

"In the treatment of cancer hidden deep beneath the skin one of the limitations is the amount of X-rays which the skin can tolerate during treatment," Dr. Hawley states. "The X-rays must pass through the skin before penetrating to the cancer, and, since the skin is closer to the X-ray tube, it is subjected to a larger dose than the cancer. . . To get a larger dose into the deeply situated cancer without harming the skin, it has been common practice to aim two, three, four or more beams of X-rays at the cancer through separate areas of the skin. This allows a large dose to be given to the cancer while spreading the dose over a large area of the skin."

Dr. Hawley's method is to spread the dose over the largest skin surface while always aiming the beam at the cancer; he places the patient on a turntable and rotates him during the treatment. The patient is positioned on the turntable so that the cancer is centered on the center of the turntable and the X-ray beam is aimed at the cancer.



Childhood mortality (ages 1 to 14 years) by cause, from 1911 to 1939

BROWSING with the Editor

THROUGH THE SCIENCE LITERATURE OF THE WORLD

WE CONSUME—The average American each year requires only 30 pounds of textile fibers and a ton of food; to meet his power demands, however, he burns 10,000 pounds of coal and oil and salvages still more energy from waterfalls, wood, and wind.—*The Industrial Bulletin* of Arthur D. Little, Inc., No. 160.

OUR DAILY BREAD—Three pounds of food and four pounds of water a day will keep the body functioning, but these would be of little use without 34 pounds of air daily. —G. R. Harrison, "Atoms in Action," page 293.

MILES OF R. R. TRACKS—If all the railroad tracks in the United States were so laid out, they would form 133 parallel tracks between New York City and San Francisco.—Association of American Railroads.

LEGS GROW MAINLY NEAR KNEES—Contrary to what one might assume, the leg bones do not make their longitudinal growth at the same rate throughout their length. Most of the growth occurs in the region of the knee joint. —*The Journal of the American Medical Association*, August 10, 1940, page 479.

MAN'S BUMP DEFLATED—Recent work by Federal entomologists shows that when mosquitoes have free choice they prefer horses and cattle to human beings by about six to one. Pigs were three times as popular as humans. Dogs were lightly preferred. Man rates just ahead of chickens and cats as a preferred source of the blood meal which most of the biting mosquitoes require before they can begin depositing eggs.—Notes, *Journal of the Franklin Institute*.

SIZE OF RHODE ISLAND—Buildings cover one part in 2500 of the United States area (rough estimate). If brought together they would cover an area about 35 miles square.—*Popular Astronomy*, August 1940, page 369.

CIGARETTE SMOKE—A few lighted cigarettes can quickly fill an ordinary room with smoke, but the particles are so tiny that it takes 320 cigarettes—16 packs—to make one ounce of smoke particles.—Notes, Westinghouse Electric & Manufacturing Company.

STRAIGHT TRACK—A perfectly straight track—78.86 miles in length — on the Seaboard Railway between Wilmington and Hamlet, North Carolina, is the longest stretch of track in the United States without a curve. —Association of American Railroads.

IMPURE METAL—No metal has ever been made so pure that the spectroscope could not find impurities in it. Even the superfine, extra-pure, 1000-proof gold which is the basis of the currencies of many countries is found to contain much atomic dirt under this revealing eye which sees through atoms.—G. R. Harrison, "Atoms in Action," page 165.

UNLUCKY FRIDAY—The reluctance of seamen to sail on a Friday reached such proportions that many years ago the British government decided to take strong measures in proving the fallacy of the superstition. They laid the keel of a new vessel on Friday, launched her on a Friday, named her H. M. S. *Friday*. Then they placed her in command of a Captain Friday, and sent her to sea on Friday. The scheme worked fine, and had only one drawback—neither ship nor crew was ever heard of again.—*Our Navy*, Mid-August 1940, page 15.

POWER DIVE SPEED—A modern plane doing a power dive is moving as fast as a revolver bullet.—G. R. Harrison, "Atoms in Action," page 319.

50,000 PILOTS—The Civil Aeronautics Authority, charged with responsibility for training 50,000 civilian pilots by next June 30, already has launched more than 32,000 students in ground schools and 17,494 in flight courses in its Civilian Pilot Training Program.—Robert H. Hinckley, Assistant Secretary of Commerce.

LARGEST U. S. LINER—During her recent sea trials, the S. S. *America* exceeded both power and speed requirements, and also bettered her guaranteed fuel consumption figure. Designed to develop 34,000 shaft horsepower normally, she averaged 38,500 shaft horsepower during an overload test in the trials. Her contract speed was bettered by over two knots.—*The Log*, July 1940, page 24.

DESERT BUSINESS—Death Valley, commonly thought of as an uninhabitable desert, has its attraction for visitors. It is extimated that visitors spent more than a third of a million dollars in Death Valley during the season of October 1938 to May 1939.—*Economic Geography*, July 1940.

LANDING BY INSTRUMENT—The instrument landing system [for aircraft] at Indianapolis is the most extensive and most complete system installed anywhere in the world. It is an installation providing for instrument approaches and landings in four different directions. All of the 16 stations involved are completely controlled and monitored from the airport control tower.—*Journal of the Aeronautical Sciences*, July 1940, page 383.

ARMAMENTS COST—During the past five years, expenditures for armaments for the nations were, in American dollars: Germany, 19.0 billions; Russia, 13.5 billions; England, 6.2 billions; United States, 5.1 billions; Japan, 5.1 billions; France, 4.9 billions; and Italy 3.7 billions. In the United States and Engand, and probably in France, less was obtained per dollar than in the other, low-wage countries.—Statistics by Colonel Leonard Ayres, Cleveland Trust Company.

RUINATION THAT DID NOT MATERIALIZE—The consumption of marihuana in the United States, which had for several years increased, has recently been effectively checked.—*Science*, August 9, 1940, page 118.

PETROLEUM—Underground waste of oil virtually has been eliminated in the development of America's oil reserves. More than 99.5 percent of the recoverable oil known today in underground reservoirs ultimately will be produced by a continuance of present production methods.—Notes, American Petroleum Institute.

ICE CREAM COWS—The total production of more than 1,000,000 cows, supplemented by many tons of fruit and other ingredients, goes to supply the 1,200,000,000 quarts of ice cream which Americans consume annually.—*Telephone News Bulletin*, August 1940.

How Big Does The Moon Look?

In Which it Turns Out that Astronomy Has Something to Learn from Psychology

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THERE are some problems, related to astronomy, and perfectly susceptible to investigation by scientific methods, in which training in astronomical observation practically disqualifies one as an investigator.

A very pretty instance of this sort was recently reported to the National Academy of Sciences by Professor Boring of the Department of Psychology at Harvard, and later discussed with great interest by a large group of astronomers, old and young, at the Harvard Observatory. It deals with the old, every-day question: Why does the Moon look larger when it is low in the sky, near the horizon, than when it is high in the heavens?

Practically everyone, educated or uneducated, agrees that it does, except a very few hardboiled astronomers; and it is practically certain that these exceptional folk, being convinced that the Moon does not really look any bigger near the horizon, have trained themselves to disregard the ordinary "evidence of their senses."

This seems a very queer phrase to use; for there is of course no doubt whatever that the true angular diameter of the Moon, when seen near the horizon, is no greater than when it appears in the zenith. This is true, no matter whether the diameter, in minutes and seconds of arc, is measured with a sextant, or whether photographs are taken with the same telescope or camera, and is certainly true also of the image of the Moon produced on the retina of the eye by its own lens apparatus.

Other things being equal, the Moon actually looks *smaller* near the horizon; for, at any given instant, it is nearly 4000 miles farther away from an observer who sees it on his horizon than at his zenith, and so appears smaller by 1/60 of its apparent diameter. This effect, though very easily measurable with instruments, is too small to be perceptible to the unaided eye.

The changes in the Moon's angular diameter with its changing distance are much greater, and extend over a range of more than 10 percent. These could easily be seen without optical aid, by comparing the Moon on different nights with an artificially illuminated disk of fixed size and distance—say three inches in diameter and 27 feet away—but are not great enough to be detected by comparing what we see one night and what we remember of another. (Should any one wish to try the experiment, the disk should be put at a considerable distance, so that the differences in focus of the eye do not disturb the observations—which, of course, must be made with one eye only.)

THE increase of the Moon's apparent size near the horizon is therefore a phenomenon of psychology, and not of physics. The *angular* diameter is sensibly the same; but the *appearance*—that is, the conscious perception which follows automatically upon the sense-impression—is very different.

Does our sense of vision then deceive us in this case? Before we answer, we must consider that what we perceive, when we look at an object, or hear a sound, is really an interpretation of our sense-impressions rather than the impressions themselves.

This process of interpretation must start very early indeed in our lives. We can none of us remember when we learned that the person who walked across the room toward us was not really growing bigger, but coming nearer. The perception of an individual of fixed size coming nearer displaced that of an enlarging retinal image, long before we had words to express either. We left the unsophisticated impressions of infancy, and learned to substitute an interpretation based upon more complex experience so thoroughly that we are quite unconscious that we are doing it.

Familiar instances of this kind exhibit the almost universal fact that what seems to us to be the immediate evidence of our senses is a complex compound of the real sense-impressions and a mass of sub-conscious interpretation, based on our whole previous lives, and depending on a multitude of "cues" not part of the immediate sense-impression, but relevant to its interpretation.

In looking at something at a moderate distance, we have the focussing of the eye on a near object, and the convergence of the two eyes, which gives the stereoscopic effect. Both involve muscular adjustments which, though made without conscious attention, powerfully influence our distance-judgments.

Professor Boring and his colleagues—trained psychologists, whose observations of their perceptions were not prejudiced, as are those of astronomers, by too much thinking about how the Moon ought to look—have found that the Moon, even high in the sky, produces the impression of looking as big as a disk 10 or 12 feet away, and of nearly four times its real angular diameter, while near the horizon it looks almost double this size. When the influence of extraneous factors is weakened, as by observing with one eye instead of two, by looking down a long dark tube, and so on, these effects diminish.

Another set of external "cues" come from the position of our head and eyes. If we look at a low Moon, our heads are normally poised, and our eyes nearly level—that is, with the eyeballs in their normal position. To see a high Moon, we must throw our heads back and turn our eyes up. That these muscular adjustments have the principal influence upon the "horizon effect" is conclusively shown by the work of the Harvard psychologists. When an observer lies flat on his back, and looks up at the sky, so that his head and eyes are in a normal position when he looks straight up, a high Moon looks big to him, and a low Moon, to see which he has to bend his head back, looks smaller. Curiously enough, the same is true of a low Moon in

the direction of his feet, for which he has to bend his head forward, and his eyes down.

Many other ingenious experiments confirm the conclusion that the position of the head and eyes is the principal factor which conditions our perception of how big the Moon looks. The fact that the Moon looks smaller if it appears to be below, as well as above, the observer's personal horizon, at right angles to his backbone, has naturally not been a matter of direct celestial observation.

In the summer of 1918, Dr. D. L. Webster—now Professor of Physics at Stanford, then a Captain in the United States Air Service—and the writer were engaged in work on airplane navigation at Langley Field, Virginia. One Sunday afternoon, when no work was being done, we were out on Hampton Roads in a sailboat—incidentally looking at the ships of the Atlantic Fleet, anchored in the Roads. Next morning we were flying over the same spot—at perhaps 4000 feet—and we noticed independently that the warships, though at the same distance, looked from the air like toys—very much smaller than when seen on the level. The impression was so striking that we commented upon it after our return. Conversation in the aircraft of that date during flight was hardly possible, so that our impressions were strictly independent. Both were experienced in physical observation and both familiar—one highly so—with things seen from the sea and from the air.

The question remains: Why should an object, of the same angular subtense, produce so definite an impression of being largest when it is on or near the horizon? In the writer's opinion, the answer is to be sought in common experiences, involving an interpretation which, though geometrical in nature, is so simple that no formal knowledge of the science is required for it. Consider first, objects below the horizon. We are all used to looking down from a height, a housetop or a tower, hill or mountain. (In these days, one might add an aircraft; but there has not been time for these actual birdseye views to become familiar enough to get into the sub-conscious level.)

In the most of such views, we are looking down from a height upon a substantially flat surface—garden, field, or plain. The most rudimentary geometrical sense indicates that an object which appears at a large angle of depression, far below the horizon, is nearer us than one for which this angle is small; and it follows immediately that, of two objects of the same apparent angular extent, the more distant one must be much the larger. We thus soon unconsciously learn to use different scales of real size for bodies of the same angular extent, but different angles of depression.

This is simple enough; but why do we do the same thing for the Moon, in the featureless vault of heaven? The answer, I think, is that the sky is not always featureless. The stainless blue of a perfect day has little about it to make the sky seem nearer in one part than another; but, even then, the paler blue near the horizon suggests haze, and we all associate haziness of appearance with greater distance.

But, very often indeed, the sky is clouded, wholly or in part, and more often than not, the clouds form an obviously flat ceiling at a definite (though not obviously measurable) height above the earth. Looking at such a ceiling from below we are geometrically in very closely the same situation as when we look down on a floor from a height. The part of the ceiling directly overhead is the nearest, and the distance of other parts increases steadily with diminishing angular altitude above the horizon. An isolated cloud, in a layer of broken clouds like the familiar "mackerel sky" will be smallest for the same angular extent, near the zenith, and larger and larger the nearer it is to the horizon.

In the language of the geometer, we project the observed pattern of clouds upon a plane surface at a fixed height above the earth, to get an approximate idea of the real dimensions of its components. What we do practically is far simpler than this technical statement would suggest and is "obvious to the meanest intelligence."

It is not clouds alone that call for such subconscious estimates. Birds, especially migratory birds, usually fly nearly horizontally, and everyone who knows the country at all must have seen a flock of crows change from mere specks low on the horizon to clearly-seen birds overhead, only to shrink again as they go on their way.

These are common observations, which must have been part of human experience since men began to recall and act upon their past impressions. It is no wonder that, by this time, we have sub-consciously adopted different scales of real size for bodies high above the horizon and low down. Rather may we wonder why the impression that the low Moon looks bigger amounts barely to a doubling in size instead of an increase of five or ten fold.

It may be suggested that very near the horizon flying birds are too remote to be seen, even as specks, and distant clouds are lost in haze. Moreover—as everyone recalls who has seen a sunset at sea under a layer of scattered clouds—the clouds at very low angular altitude do not flatten out into nothingness as perspective on a plane would demand, but remain of finite size right to the horizon. They are distributed on a spherical shell concentric with the earth—and the sense that clouds right on the horizon are not enormously more distant than those at an altitude of two or three degrees must have arisen long before the true geometry of the case was understood.

When we can see the actual horizon, our sub-conscious correction-system is automatically referred to it. When we cannot, Professor Boring's researches show that each of us has a personal horizon of his own—referred to his backbone as principal axis—with respect to which the illusion still persists—or, rather, the rational, though unconscious, attempt to make better sense of what we see than mere crude unthinking seeing would do.

Further tests of this interpretation are possible. It would be very interesting to find out whether dwellers in mountain-sides, who, from babyhood, were used to seeing objects at large angular elevations and depressions, but at about the same distance, were subject to the "illusion." Observations from aircraft might also tell something. The writer vividly recalls the Moon sweeping from his subjective horizon to the zenith and beyond to the horizon in a few seconds, while the plane in which he was looped-the-loop at night, and has no recollection that it appeared to change in size. But the time of observation was too brief and the conditions otherwise too unusual, to make this recollection of psychological value.—*Jamestown, Rhode Island. July 19, 1940.*

When You Steer a Motor-Car

Mechanism Has been Designed to Indicate Steering Deviations When Car is Rolling

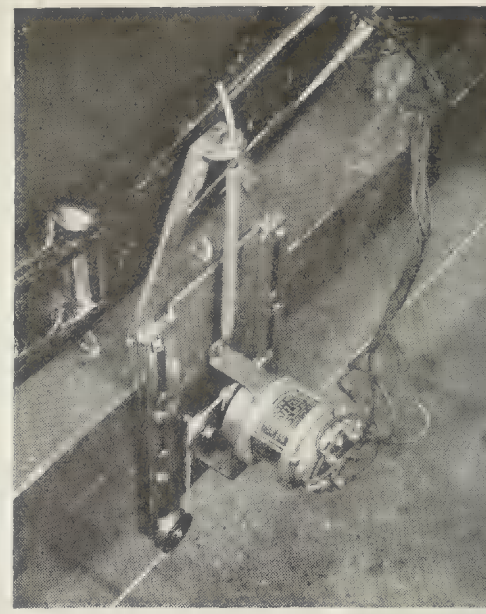
A. P. PECK

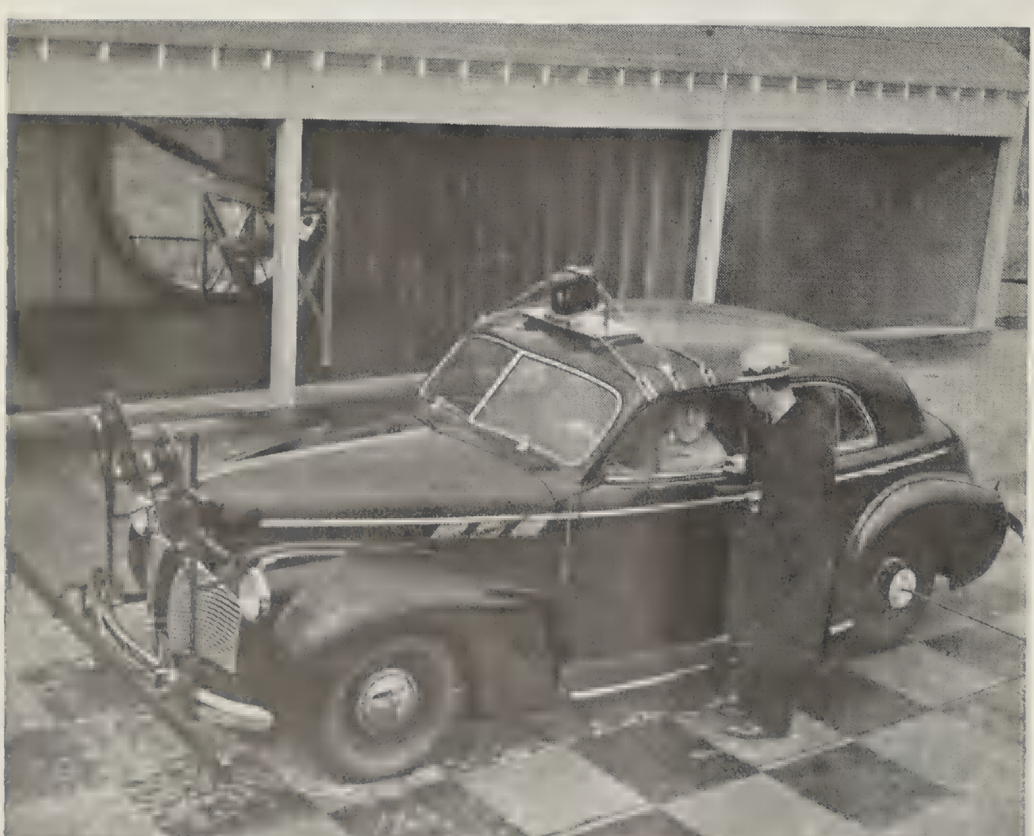
ONE of the main objectives of motor-car engineers is to design an automobile that approaches self-sufficiency, that virtually steers itself, that makes less demand on the attention of the driver as far as keeping the car on a straight path is concerned. This apparently simple problem involves many parts of the car, as well as such external influences as wind pressure on the car body. The separate actions of the steering gear, of all four wheels, of the chassis itself, contribute to the final result. Yet these actions do not take place until the car is in motion; hence they are difficult to record and study.

In order to determine the directional adjustment demanded by the modern motor-car—that is, the amount of steering which the driver must do to keep the car on a true course—and to obtain at the same time accurate data on the actions that necessitate this adjustment, engineers of Pontiac Motors have designed elaborate equipment that does what was heretofore considered impossible. It makes records—24 of them a second—of exactly what happens to vital parts of a car when it is in motion over a road. With these records available for leisurely study in the laboratories, the engineers are enabled to place their fingers on "reasons why" that might never be found otherwise.

The equipment used involves a standard movie camera rigidly mounted on the roof of the car under test, a set of four dials placed on a bracket attached to the front bumper, means for actuating these dials, and a section of Proving Ground track painted in a checkerboard pattern. Available also is a huge airplane propeller with which cross winds of varying velocities can be simulated as desired. Supplementing all this is laboratory mechanism for studying and analyzing the movie film after it is processed.

Accompanying photographs show details of the equipment. Attached to the steering wheel and to each of the front wheels are small "autosyn" motors by means of which any

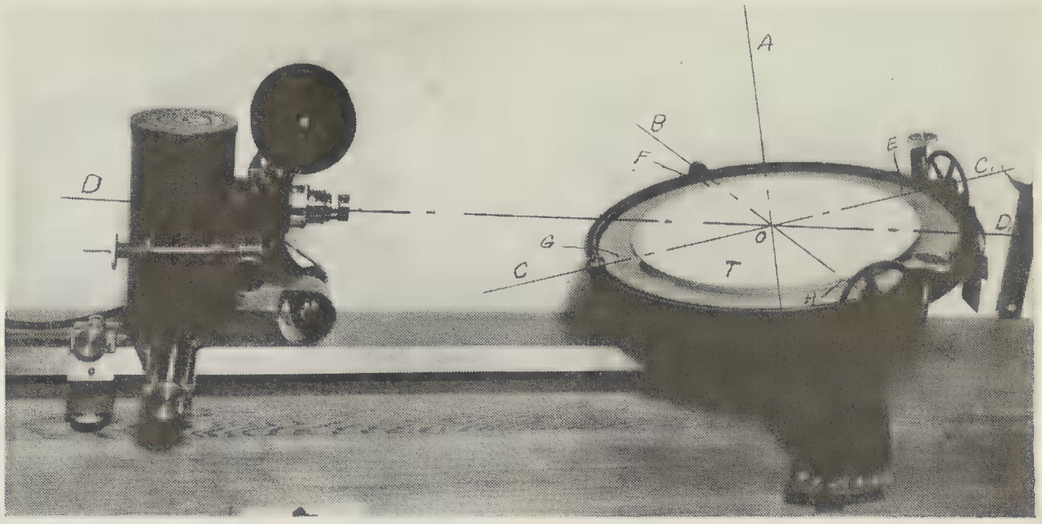




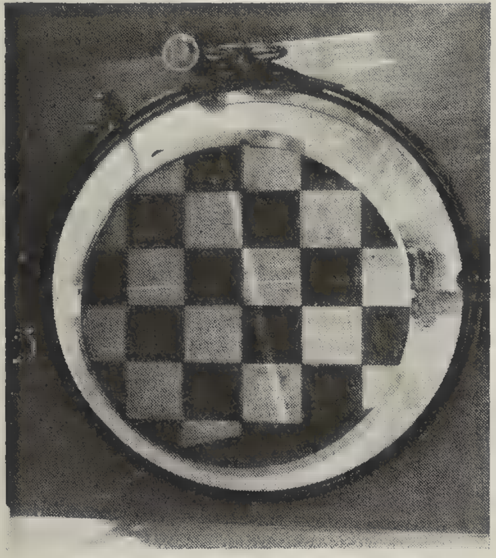
Below: Set-up of equipment on motor car for recording those factors which contribute to the necessity for directional adjustment. _Right:_ An enlarged frame of movie film taken by the camera on top of the car. Here are recorded the checkerboard background and the four indicating dials. _Upper right:_ The "autosyn" motor, mounted on the front bumper, transmits, to its dial, indications of horizontal rear axle movement

movement of these three units are recorded on three of the four dials. Mounted low on the front bumper is another "autosyn" motor which is coupled through piano wire to extensions of the rear axle. This arrangement is so devised as to indicate, on the fourth dial, any tendency of the rear axle to move in a fore-and-aft direction.

When the test car is placed in motion over the checkerboard track, the movie camera starts to click off 24 frames a second. This camera is so aimed that it photographs simultaneously the four dials as well as that part of the track directly in front of the car. Thus is obtained a continuous record of the motions of the steering gear, of the front wheels, and of the rear axle, all correlated with the precise direction of the car as it travels along the checkerboard.



Movie projector at left throws film images on turntable at right. By means of accurate adjustments of table, valuable engineering data are obtained



Turntable and checkered disk for studying the movie film records of steering deviations

After the movie film is developed, there comes the laborious and painstaking study of the records and what they indicate. In the laboratory is a turntable on which is mounted a disk ruled off into perfect two-inch checkerboard squares. The turntable is movable in all directions, its motion being controlled by screws. Any displacement of the turntable can be read, on calibrated scales, to degrees, minutes, and seconds. A single frame of the movie film is projected on the disk, and the checkerboard image on the film is accurately aligned with the squares on the turntable. When this registration is achieved, it is obvious that the disk bears the same relationship to the camera as the camera did to the road when the film was exposed. Thus, by comparison of successive frames of the film it is possible to calculate precisely the path of the car and the car's steering abilities. The indications on the four dials show exactly what was happening at any split-second when the car deviated from the straight path. From these data it is possible to eliminate "bugs" in design and to perfect not only steering mechanism but also other car parts that directly influence the steering of the vehicle.

The mechanism described was developed under the direction of Thomas Carmichael, physicist in charge of instrumentation at General Motors Proving Ground, and William H. Manning, assistant chief engineer of Pontiac. Says Mr. Manning: "The information we have gathered and will continue to obtain by the 'checkerboard test' makes possible the development of a car whose safety built-in characteristics must of necessity supplement the driver's inherent ability."

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Carbon Dioxide on Wheels

Industrial Plants and Military Airports Are Using Mobile Units Carrying Fire-Killing Gas

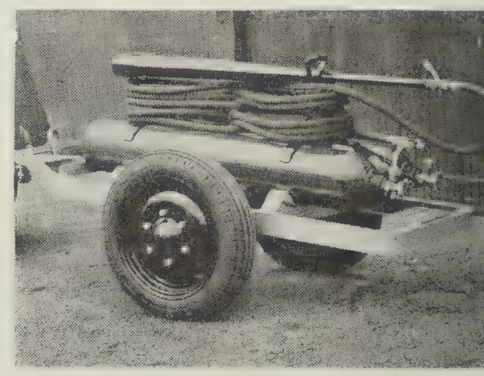
With incendiary bombs peppering European airfields and supply depots, military aviation experts are looking to fire-fighting methods which can cope with this growing hazard. A leading candidate for the job is the carbon dioxide fire-truck, a development that has proved highly successful in tests made by the British Air Ministry as well as our own naval air-base officials. The ability of the CO_2 to smother oil and gasoline fires quickly makes it doubly valuable at war-zone airfields where a fire serves as a beacon for succeeding waves of bombers if it is not immediately extinguished.

Carbon dioxide fire extinguishing is not a brand new development, having been used for some time by oil refineries and other industries where flammable liquids constitute a hazard. But the mounting of high-pressure cylinders, containing large quantities of the gas, on swift fire trucks which can dash around a far-flung airport and extinguish all manner of fires with clouds of the white vapor, is a recent advance. This extinguishing technique has gained support as a result of its successful use by London A.R.P. squads.

Carbon dioxide, which is also used in aviation and marine installations in the form of small built-in systems for smothering engine compartment fires, functions by diluting the oxygen content of the air around a flame to a point where fire cannot burn. This dilution is extremely rapid and the gas penetrates into crevices and past

obstructions which might hamper liquid fire-extinguishing agents. Carbon dioxide, which becomes a liquid when compressed and turns to gas and snow when released, is harmless to human skin and materials, and recharging of the cylinders is quick and relatively inexpensive. Pressure within the steel storage cylinders is approximately 850 pounds per square inch at 70 degrees, Fahrenheit.

In addition to this main extinguishing agent, most of the new airport trucks are equipped with derricks and grappling hooks which can be thrown over airplanes to pull them out of range of a fire. Ladders, asbestos suits, and gas masks for rescue work are other items of equipment provided for on these trucks, which are usually built on a commercial chassis and have speeds of 50 miles an hour.



***Above:* Airport fire-fighting truck that carries 1000 pounds of compressed carbon-dioxide gas as well as grappling hooks and a derrick. *Left:* A motorcycle unit used by the Navy. *Right:* A small trailer unit carrying 150 pounds of the gas**

The gas cylinders are usually stored in banks at the rear of the driver's cab, and are manifolded to hose-reels which give a range of several hundred feet in all directions. A supply of charged replacement cylinders is usually kept so that the truck can be used during recharging, which takes but a few hours. Some truck models carry water-pumps, while those built for combat zones are usually made as self-sufficient as possible and carry their own supply of water in tanks —for use on hangar fires if hydrants and mains are damaged.

Of the trucks so far ordered—and hundreds have recently been put into service at British airfields and training schools—few have had gas capacities of more than 1500 pounds, although tons of gas can be carried. Engineers estimate that 1200 to 1500 pounds of gas is ample to envelop several planes and to enable rescue workers to get to the occupants.

To supplement these larger units, or for use on smaller airports or manufacturing properties, a number of trailers and motorcycle units have been developed by the New York engineering firm of Walter Kidde and Company, who have also designed and produced many of the larger trucks. The trailer units, which can be hooked to any handy truck or automobile, or even trundled to a fire by a couple of men, usually carry upwards of 300 pounds of the carbon-dioxide gas and are equipped with hose-reels and long nozzles to give the unit a wide effective range. The motorcycle units, several of which have been purchased by American military fields, carry large quantities of the gas and can accommodate two or three men as they dash around an air-base. They also carry portable cylinders of the highly compressed gas which can be lifted off and carried to the seat of a blaze.

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NYLON

Slow Competition with Silk

Now that the first excitement over the introduction of nylon hosiery has subsided, people are beginning to wonder how deeply nylon will cut into Japanese silk production. Ordinarily the business of producing silk supports two million Japanese farmers and another half million people who reel and handle silk.

Though American production of nylon will be rapidly increased, it is said that the full force of its competition will not be felt by the Japanese silk industry for five to ten years. By that time Japan can have readjusted her economy as she did when rayon was first introduced. At that time she turned to production of the new fiber and is now one of the world's greatest rayon producers. She may follow suit with fibers identical or comparable with nylon while silk production will be limited to supplying of a few "luxury" lines.

TURBINE SHAFTS

"Baking" Them Permanently Straight

A General Electric engineer, S. Homer Weaver, recently received a Charles A. Coffin award from his company for his method of "baking" permanent straightness into steam turbine shafts and rotors. Turbine rotors weigh up to 10 tons and must retain perfect straightness at 3600 revolutions per minute and 950 degrees, Fahrenheit, operating temperatures.

In Weaver's process, the ma-

chined-straight shaft, or rotor, is suspended in a standard lathe bed. The electric oven, sectionalized for different length requirements, is closed about it and controlled heat is applied through strip heaters. The rotor is turned at two revolutions per minute, and thermocouples riding on it give temperature readings. As the oven heat is raised, the rotor loses its straightness. Sliding rods pass through the wall and, riding against the turning rotor, indicate increasing shaft deflection as the temperature goes up. Then, at a certain critical temperature, a straightness is restored which is not affected by temperature or temperature changes. Thus the treatment is a true stabilizing cure.

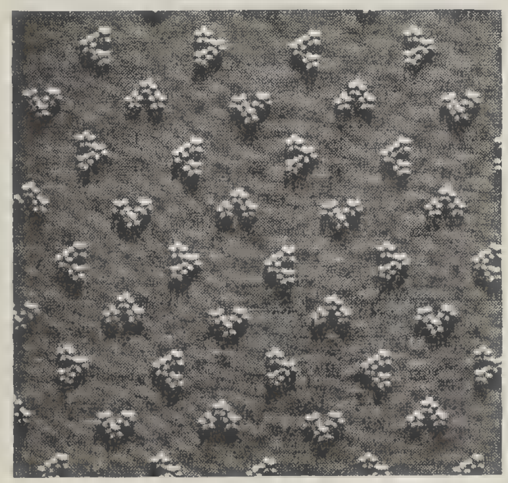
ELECTRO - COATED

High Pile Put on Textiles Electrically

"ARTIFICIAL lightning," which some years ago was converted into a useful tool for the manufacture of abrasives, is now being harnessed for an apparently unrelated purpose—the production of high-pile fabrics that resemble velvet, reports A. J. Sidford, writing in a recent issue of *The Frontier*.

Remote as abrasives and fabrics seem from each other, the principle underlying the use of electrostatic fields is the same in both cases. As early as 1926, Elmer C. Schacht produced sandpaper "coated by artificial lightning" at the Watervliet plant of Behr-Manning Corporation. This patented process is used to do three things: propel, disperse, and orient the particles. Since 1932 it has been adopted on a large scale in the manufacture of abrasives, both in this country and abroad.

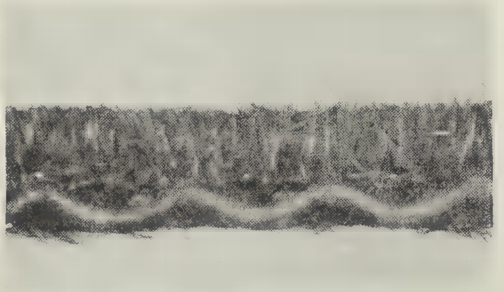
The same process was next applied to the tufting of dress fabrics, and is being employed under ex-



An "electro-coated" pattern

clusive license by Arnold Print Works. Accurately cut particles of cotton, rayon, wool, or mixtures are deposited, under the influence of the electrostatic field, in an upright position on the patterns, which have been previously coated with an adhesive.

Then came the latest step in the development—the complete covering of a cotton-backed material with accurately cut fibers. The fibers are securely anchored in a coating of vulcanized latex, producing a high-pile type of fabric that resembles velvet. The electrocoated fabrics are distinguished by depth of pile and density of coat.



Enlarged section of Norzon fabric, showing erect fibers

Wear strain is taken on the ends of the fibers, which number as many as 300,000 per square inch, and tests indicate much higher durability than the older type. These new pile fabrics, designated as Norzon, are being tested for upholstery by two leading producers of automobile bodies.

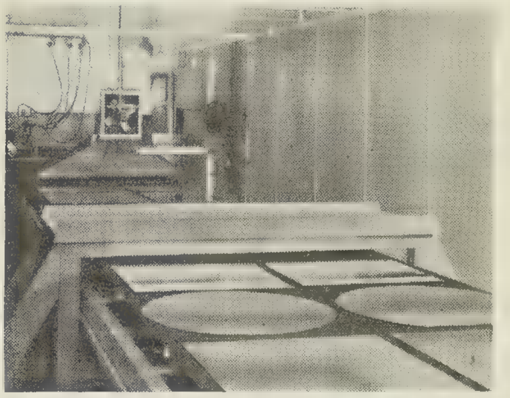
Already it is fairly well established that electro-coating can be used for carpets with a very admirable pile surface. That further research may uncover new applications seems entirely probable. A process that has already been adapted to the manufacture of abrasives and textiles undoubtedly has other uses as yet undiscovered.

MIRRORS

Made By Automatic Process

A TOUGH film of silver of unprecedented hardness is achieved in an almost wholly automatic process of mirror making developed by Logan Porter Mirror Company. The manufacturers claim that the silver solution is scientifically proportioned to every square inch of glass to be covered.

In this new process, glass plates are placed on a conveyor outside the processing rooms. Here they are flushed of all surface impuri-



Mirror production line

ties preparatory to a gentle, thorough scrubbing with distilled water inside the machines. The sensitizing fluid flows from the laboratory above to each plate in an exactly adjusted quantity and the continuously operating conveyor carries the plate to the automatic silvering device. The mirrors meet human contact only after the processing when the conveyor carries them outside the processing room to be stacked manually.

CRANBERRY CHEMICALS

CRANBERRIES, graduated from the laboratory recently, came out with a product worth $80 an ounce! Chemists call it "ursolic acid." Cranberry growers call it a lucky break. This hitherto rare, emulsifying agent which helps to make oil and water mix, is derived from the skins discarded in the manufacture of cranberry sauce. From the same "waste" product, cranberry seed oil, a rich source of vitamin A, can be obtained. Plans are afoot for a $50,000 "pilot plant" to pioneer the manufacture of the two new products.

CONTROL MECHANISM

Device Stops a Machine Error Before it Happens

A DEVICE which operates on the principle of acceleration rather than velocity and is sensitive to the rate at which a change is taking place rather than the extent to which the change has progressed has been developed in the Westinghouse Research Laboratories. It actually begins to correct something that has started to happen before it can happen. This is a new high-speed regulator which, in combination with a novel gyroscopic stability control, indicates the possibility of some promising applications for the control of mo-

tions and speeds in many mechanical operations and processes.

"Experiments now in progress," reports M. W. Smith, vice president of Westinghouse, "indicate the possibility of using this scheme for the control of tension and gage thickness of steel produced on high-speed strip mills. If this experiment is successful, it will materially reduce the scrap losses from off-gage material, which is one of the major problems in the steel industry today."

CLOTH TESTER

Machine Wears Surface Under Test Conditions

DEVELOPED for industrial use in determining abrasion resistance of plated metals, for example, the Taber Abraser has been adapted to testing of woven fabrics. This adaptation is based on the continuous rotary principle, though the pressures against the specimen are considerably smaller than those employed in the larger abraser for use on paint surfaces.

In the rotating head, a piece of the fabric to be tested is clamped tightly by the special ring that is employed for this purpose. The motor then rotates the head at a speed of 60 to 70 revolutions per minute and the test is continued until the two abrasive wheels have worn the fabric to an appreciable degree. Comparison between different kinds of cloth may easily be made by running each for the same period of time under the wheels of the abraser; the wearing quality of each may be determined under test with strict controls.

Above: **Compact cloth tester in use.** *Below:* **Typical cloth sections after test, showing how surface is worn by the Abraser**

TACHOMETER

Needs No Contact with Rotating Part

OFTEN it is desirable to check the speed of rotating or vibrating parts when it is impossible to get at those parts with an ordinary tachometer. Such is the case, for example, with electric refrigerators, vacuum cleaners, electric shavers, concrete vibrators, and similar equipment. James G. Biddle Company has developed an instrument which overcomes this difficulty. The new instrument, called the Frahm Hand Tachometer, is of the vibrating reed type and needs merely to be held against some part of the machine whose rotational or vibrational speed it is desired to learn. In the accompanying photograph it is shown taking the speed of a vacuum cleaner.

When determining the speed of rotating parts with a new tachometer, it is only necessary to hold the tachometer case in contact with machine housing

The principle of this device is as simple as a tuning fork. The sole mechanism is a set of very accurately tuned steel reeds. On the principle of resonance, certain of these reeds become energized by the vibration of the machine on which the instrument is held or mounted. The speed of the machine is then read on the scale of the instrument.

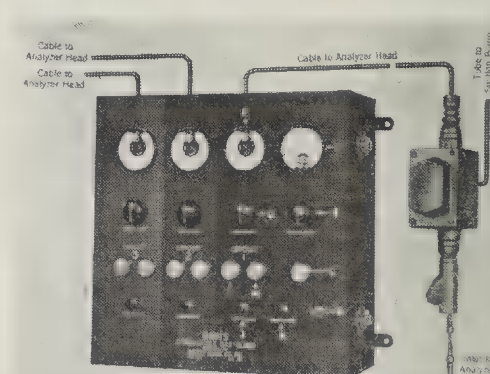
The advantages of this device are that it requires no contact with the rotating element, imposes no load on even the smallest motor, can be used in any position, does not have to be oiled, and has no wearing parts, no magnets, or electrical connections.

GAS ATMOSPHERES

Indicator Keeps Constant Watch on Explosive Mixtures

IN industries where hazardous mixtures of air and gases of any kind occur, it has been common practice to draw a sample of the mixture into a container which is then carried to a laboratory for analysis. On the results of such a test, certain manufacturing controls or changes in operation may be made. In this process there is not only a delay but also the possibility that the sample of the mixture may become contaminated.

An analyzing unit called the Davis Continuous Combustible Gas Indicator prevents all such errors because its analyzing head is installed immediately in the area to be tested. This indicator consists of one or more analyzing heads, a panel box, and a pump. The sample of gas and air mixture is drawn through only a few inches of tubing and the determination of the mixture's characteristics is instantaneous. Each analyzing cell, of which there may be a number installed at various locations, forms a part of a complete Wheatstone bridge circuit, the other half of the circuit being located in the panel box which is the indicating part of the system.



Panel box and analyzing head of new combustible gas alarm

INDUSTRIAL TRENDS

CEMENTED CARBIDES

THE first World War saw the introduction of a material in Germany which has become an indispensable aid to domestic production in the present holocaust. This material is cemented carbide. (See Scientific American, February, 1935.) Introduced to this country in the late twenties, the technique of manufacturing it to desired forms as well as the knowledge of how to use it in industry has improved by leaps and bounds. Now the pressure of war preparation has brought it into full flower.

Tools tipped with cemented carbides have permitted acceleration of metal cutting operations a hundred fold; and progressive manufacturers were fairly prompt to adopt them. Now, even the backward producer must employ cemented carbides or fall behind because defense preparation allows no lagging. Likewise, the marginal producer climbs aboard because it's necessity, not choice, which governs use.

MACHINE TOOLS

You have heard lots about the shortage of machine tools and the high rate of obsolescence, but you rarely hear of the part the cemented carbides have played in bringing about this situation. Machine tools wear out, but cemented carbides made them obsolete. Old-style machine tools would not permit maximum use of cemented carbide tools. They couldn't stand the punishment inflicted by the high operating speeds, hence much of the machine-tool replacement of recent years has been done to bring equipment into line with modern practice. Fortunately for industry, machine-tool builders re-designed their product long before the present emergency.

Incidentally, the centers of machine-tool manufacture are humming day and night. A superficial survey of plant expansion made the other day revealed that more than 300,000 square feet of new manufacturing space is about to go into use.

CIGARETTE PAPER

It seems most likely that laymen will feel the annoyance of war in small, incidental ways—at least for some time to come. Apropos of this I anticipated trouble to the cigarette manufacturers due to the shutting off of paper from French mills. But it develops that American mill capacity can be expanded to meet all needs and that there is plenty of flax grown in the United States to make all the paper we can use. We already have a small production and a new company got into operation about a year ago. Thus tragedy becomes an opportunity.

SHEET-WIRE

No industrial process is free from the possibility of revolutionary change, looking to lower costs and better quality. Among the recent upsets, for which there is promise, is a wire-producing process which ignores the customary multiple drawing operations. Here's how it works:

The first step is to butt-weld strip to permit continuous operation. The strip is then grooved longitudinally between forming rolls. Next step is to pass the grooved strip over vertically staggered slitting rolls to separate the strands. At this stage an eight-sided wire emerges. The finish operation, conducted in two stages, puts the strands through trimming dies to give the wire 16 sides (cross-section), but if wholly round wire is desired, a pass through a semi-drawing die does it.

It should be noted that annealing and pickling operations are eliminated by this process as well as the use of multiple drawing dies. Sponsors of the process are going to apply it to the manufacture of wire rod and hex bar direct from sheet bar, with the promise of cost saving.

POWDERED IRON

A plant for the production of powdered iron has been projected for the West Coast, now that imports from Sweden are no more. This news is significant for two reasons: It represents a capitalizing on world trade dislocation to the benefit of domestic industry; it is proof of growing commercial importance of metal powders.

Powder metallurgy evolved from the need to handle metals too refractory to be melted or cast conveniently. First application was in production of tungsten filament. (See February, 1939.) It also permitted the combining of components which would not alloy properly because of extreme differences in melting points or because of immiscibility. Since then a host of applications have been developed.

What will be attempted in California is the gas-reduction of iron ore—novel in itself—with the stated benefit of obtaining a high purity product and accurately controlled carbon content due to the low temperature employed, which reduces the iron without a coincidental reduction of the oxides. Also claimed by the sponsors is the opportunity to utilize large deposits of iron ore hitherto blocked by the lack of coking coal. Large-scale user of powdered iron is the automobile industry, finding that many small parts can be made cheaper and better by compressing and sintering powders to exact form.

SELF-SUFFICIENCY

Whatever our capacity to meet the exigencies of trade stoppage, whatever our ingenuity at substitution, time is the all-important factor in reaching self-sufficiency. For this reason, every move made right now may be worth a hundred frantic moves made later. Here, then, is progress to provide a cheery note:

Anaconda Copper Mining Company announces the breaking of ground for a smelter, capable of producing 100,000 tons of manganese annually, starting six to nine months from now. Manganese is an essential in steel production, which puts it at the top or near top as a strategic material. A new process for extraction from low grade ores makes this project feasible.

American Cyanamid Company, looking to the time when artificial rubber will swing into big production, is undertaking large scale manufacture of acrylic nitrile, one of the essental components of Perbunan.

Koppers Company announces building of a plant for the production of ammonium thiocyanate crystals, hitherto imported. This chemical, recovered from manufactured gas, is a base for many resins, has application in the textile, chemical, and metallurgical industries.

—*Philip H. Smith*

The Evanescent Mesotron

With Knowledge Incomplete, Science Strives to Account for some Puzzling Phenomena

C. W. SHEPPARD

ONE day in 1937 physicists studying the cosmic rays discovered another new sub-atomic particle. This new physical specimen they named the mesotron, sometimes meson. It was about 180 times as heavy as an electron and carried the same charge.

Almost at once, a few of the Olympian souls who breathe the rarefied air of theoretical physics announced that this new particle would turn out to be one of the most important discoveries of the decade. There are two reasons why they believe this to be true. Let us consider the first.

As most persons know, the atoms out of which matter is constructed are tiny "solar systems." Each has a central nucleus and a number of electrons revolving around it, like planets around the Sun. After many years of hard work, scientists have managed to push their explorations inside this outer group of electrons and actually find out what the tiny nucleus is made of. They will now tell you that it is a collection of two kinds of particles —neutrons and protons. These particles weigh almost the same—about 1800 times the mass of an electron. The proton carries a single electric charge, the neutron does not. One can picture the average nucleus as a collection of protons and a slightly larger number of neutrons. They cling together like a sort of popcorn ball, each one touching the next, and they perform an irregular spinning, vibrating, and churning motion around each other.

But all was not plain sailing. The thing which had to be explained was the nature of these sticking forces which caused the nucleus to be held together so powerfully against the natural electrical repulsion of the positively, and, therefore, like-charged, protons. This glue-like force behaves in such a strange manner that it cannot be an electrical or a gravitational attraction but must be something new. Electrical and gravitational forces act in a characteristic manner; they exert their influence over a large distance. For example, in the case of the attraction of the planets of the solar system, the gravitational force of the Sun acts with great strength over a distance of many thousands of times the size of the Sun itself. Nuclear forces, however, are entirely different. If one could get in and pry out one of the particles, he would find that this took a tremendous effort; but, once he got the particle out a little way, it would snap free and the force would drop off sharply. Furthermore, the force is such that any particle in the nucleus is acted on by only a few other particles nearby, while the rest of the nucleus has no effect. These peculiarities of nuclear forces have convinced scientists that they are here dealing with a brand new force hitherto unknown to physics.

THEORETICAL physicists sharpened their pencils and went to work on the problem of these forces. It soon became evident from theory that the force which a neutron and proton exerted on one another could be explained only if the two particles were constantly exchanging places. This may seem a strange idea, but to the physicist it was no more strange than many other recent ideas about physical forces. To explain it, consider for a moment the electrical force between two electric charges. How can one charge act on another which may be a long distance away? How can it cause that distant charge to move and how can it impart momentum and energy to it? One modern explanation says that the one charge gives out electrical disturbances, or "protons," such as constitute light and other so-called "ether vibrations," and that these electromagnetic corpuscles are absorbed by the other charge and act as energy and momentum conveyors between the charges.

In 1935, this idea suggested to the Japanese physicist, Yukawa, that nuclear forces also possessed "carriers." But, unlike electrical forces, the nuclear forces require the proton and neutron to change places, as stated before. Yukawa explained this by saying that, in this case, the carrier was a charged particle. If it were positively charged it could leave a proton, changing it to a neutron; and arriving at a neutron, it would change it to a proton (Figure 1, left). If the carrier particle were negative, it would do the opposite (Figure 1, right). This assumption of a continual stream of carriers going back and forth between protons and neutrons would account for the interchange forces. By a simple calculation, Yukawa was at once able to show that this carrier would weigh about 180 times as much as an electron.

After the discovery of the mesotron, two years later, it took theoretical physicists very little time to agree that this was Yukawa's carrier particle. An apparently crazy theory had carried with it a prediction which came true!

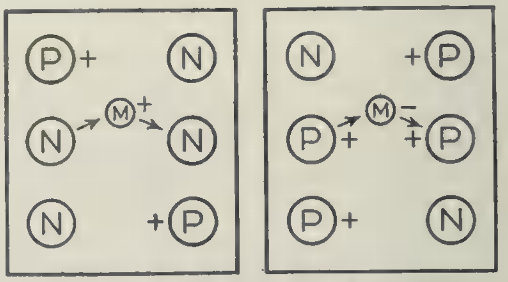


Figure 1: **Exchange of proton and neutron in atomic nucleus.** *Left:* **For a positive mesotron.** *Right:* **Same for a negative one**

The new particle soon showed itself to be important for a second reason. There are certain radio-active substances, either in nature or artificially made in the laboratory by nuclear transmutations, which eject electrons, either positive or negative. It is known that, when a nucleus shoots such a particle out, a certain definite amount of energy is let loose. Unfortunately, however, if one examines the electron after it is emitted, one finds that it usually doesn't have the correct amount of energy, but a good deal less. Scientists therefore have been forced to say that the missing part of the energy has been carried away by a phantom particle which has no charge and practically no mass—the one marked ? in Figure 2. This particle has been named the neutrino, but it has never actually been detected.

All this is bad enough, but let us consider for a moment: We have said that the nucleus consists of protons, neutrons, and carrier mesotrons alone. If this is true, where do the ejected electron and neutrino come from? The suggestion soon was made that the mesotron is not a stable particle but that it disintegrates into an electron and a neutrino. Its extra mass would then be converted into energy, in accordance with the theory of relativity, and carried away by the neutrino. Calculations showed that on this assumption the mesotron could last only a few millionths of a second before this decay process occurred.

It was at once evident that, if mesotrons decayed in this manner, it should be possible to detect the

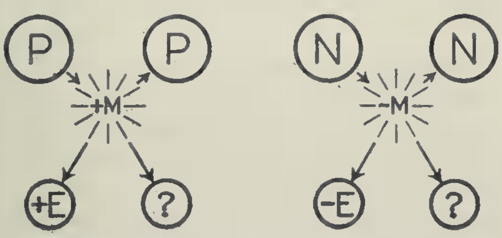


Figure 2: **New explanation of the radio-active emission of electrons from an atomic nucleus. In case I, at left, the electron emitted is positive and in Case II, at the right, it is negative**

decay in the mesotrons present in the cosmic rays. A mesotron should, in such a case, decay in its rapid course within several hundred feet of where it was produced. To test this assumption, Professor Bruno Rossi, of the University of Chicago, hauled a truckload of apparatus to the top of Mount Evans in Colorado. At an altitude of 2⅔ miles, he measured the intensity of the cosmic ray mesotrons found there. He then descended to Echo Lake, about ⅔ of a mile lower, and repeated the experiment. He compared the loss of mesotrons in the intervening ⅔-mile air blanket with the loss in traversing a block of carbon of the same absorbing power and found that less than half as many got through the air as through the carbon. The conclusion was that, in ⅔ of a mile travel, many mesotrons had had time to decay.

To settle the matter once and for all, scientists turned to the Wilson Chamber. This remarkable instrument works in the following manner: An enclosed glass chamber contains a small amount of water or alcohol. This evaporates, filling the vessel with saturated vapor. A

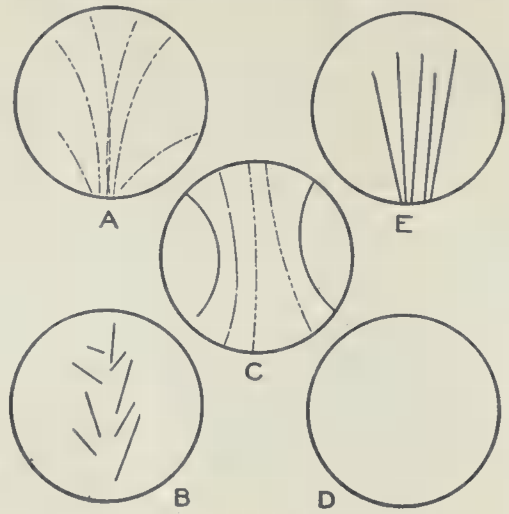


Figure 3: **How the five fundamental particles involved in modern theories of the atomic nucleus appear in the Wilson chamber.**

A: **Electrons make weak, straggling tracks which can be curved by application of a magnetic field perpendicular to the page. Positive electrons bend one way, negative the other.**

B: **Neutrons are not charged and thus cannot ionize the vapor in the chamber and leave a track. However, they are heavy enough to collide with protons, which then produce so-called recoil tracks having this characteristic appearance.**

C: **Mesotrons are hard to identify. When going fast they look like electrons; when going slow, like protons, though they curve more in a magnetic field.**

D: **The neutrino makes no track and is not heavy enough to make recoils, and thus cannot be seen.**

E: **Protons have a distinct and fairly heavy track which is practically straight except in fairly strong magnetic fields.**

piston in the bottom is suddenly drawn out. This causes expansion, thus lowering the temperature enough to make the vapor condense. The expansion is adjusted carefully until condensation just fails to occur. If now any small, charged particle, such as an electron or proton, goes through the chamber, its electrical action causes the molecules of vapor in its path to become ionized. These ions now act as centers of condensation which cause tiny droplets to form, and the result is a track which can be seen and also photographed.

Such an instrument was the ideal thing for detecting the decay of a mesotron, but it had one failing. It is only when a mesotron is going slowly near the end of its travel that its track can be distinguished from that of an electron. Thus, to the relatively rare occurrence of decay was added the further rarity of decay near the end of its course. For this reason, many pictures had to be taken to catch such a rare phenomenon in the act of taking place.

Early in 1939, the English physicist, E. J. Williams, had set out to catch a mesotron in the act of decaying. Within a few months his patience was rewarded, and he got a picture of the heavy track of a mesotron suddenly coming to an end in the chamber (Figure 3, *C*). From the end of this track came the very faint track of an electron, as called for in Figure 2. Since the neutrino, the other particle called for in Figure 2, has no charge, it produces no track and thus could not be seen.

All the foregoing work has shown that the mesotron is just about what physicists have been crying for. It casts new light on the nature of nuclear forces, explains the emission of electrons from radioactive nuclei, and strengthens one's belief in the existence of that phantom particle, the neutrino.

But there still are a few unanswered questions. It is known that forces between neutrons and neutrons, and between protons and protons, are almost as strong as those between protons and neutrons. This indicates that there must be neutral mesotrons as well as the charged ones already discovered. Certain meager evidence which has been brought forward to prove the existence of such particles has been felt to be entirely inconclusive.

Why are mesotrons not found in the laboratory? It is known that it takes about 100,000,000 volts to make a free mesotron. The only place where such energies now exist is in the cosmic rays. At present, attempts are being made at the University of California to produce such high energies with the large cyclotron.

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SPECTRO - PHOTOMETER

Analyzes Alloys By their Light

In Less Than Two Minutes

AN automatic machine which rapidly and accurately analyzes various materials, an invention expected to prove of tremendous value in accelerating the inspection of metals and alloys in the na-

tion's defense program, has been developed by Prof. George R. Harrison and his associates at the Massachusetts Institute of Technology, reports *Science Service*.

The device, known as an automatic high-speed recording spectro-photometer, not only analyzes materials, as does the spectroscope, but quickly draws the graphs and curves depicting the results of its analysis. It completes the entire process for a given sample in about 100 seconds—less than two minutes.

Heretofore, scientists have used a spectrograph to analyze the material but they have then been forced to interpret this analysis on other machines, a procedure which often required half a day or more. The new device makes records and interprets 20 measurements a second, doing so with an accuracy of one part in a hundred.

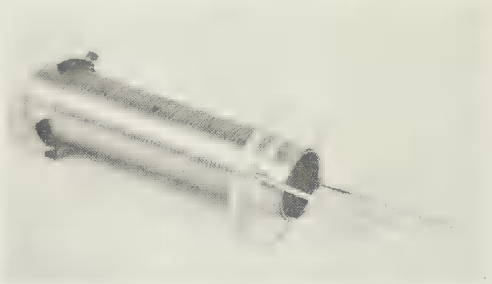
The device covers a broad spectral range, making its investigations not only in the visible range of the spectrum but also in the infra-red and ultra-violet regions. It is fairly simple in its operation and, according to Dr. Harrison, could easily be adapted to other similar problems.

HYGROMETER

Electrical Device for Measuring Humidity at High Altitudes

A NEW type of electric hygrometer has recently been developed by Francis W. Dunmore, of the Radio Section of the National Bureau of Standards. It has proved superior to other types for measuring upper-air humidities by the radio-sonde, because of its rapid response and ability to function at low temperatures. It may also be used for making and recording humidity readings when the humidity unit is remote from the point of indication. As it is comparatively small, it may be used for measuring humidities in confined spaces.

The device, which gives results accurate to within 2 or 3 percent, consists of two fine palladium wires spirally wound about 1/64 inch apart, 20 turns per inch, on a thin-walled aluminum tube which has a thin insulating coating of water-resistant polystyrene resin. The wound unit is then covered with a very thin film of partially hydrolyzed polyvinyl acetate with the addition of a small amount of lithium chloride. The latter takes up water very rapidly. With such a device the electrical resistance of the film between the two spiral coils is dependent upon the humidity of the air in contact with the film. The variations in resistance



For measuring humidity

may change the audio note which the radio-sonde transmits or may be made to operate a direct-reading ohmeter with the resistance scale marked in terms of percentage of relative humidity.

MORAL SCIENCE

Physical Science Becomes Dangerous if Dishonest

THE scientist is more honest in his work than is the politician because lack of morality in science is likely to destroy the experimenter, says Dr. Harlow Shapley, director of the Harvard College Observatory, according to *Science Service*. It is perversion of international morality, he believes, not of gadgetry, that has resulted in the decay of present-day society.

"Morality in physics and chemistry is to some extent forced," he said. "The scientist, naturally, is as human in his irrationality as others. Survival, however, requires a kind of honesty. The unmoral experimenter poisons himself or blows himself up.

"If only a false economic doctrine, while still prenatal, would also electrocute its progenitor! Or an education schism backfire during fabrication and reduce its advocate to impotent illiteracy and confusions!"

A closer communion between the physical, psychological, and social sciences was urged by Dr. Shapley as a means toward development, for the social and psychological sciences, of "a logical and rigorously experimental method similar to that which has brought such achievement in the physical sciences.

"The value of these methods," he said, "are well-publicized by the success of everyday tools. You rely on your electrical refrigerator, designed by the engineers; but you trust mighty little your politicians and diplomats. Thousands of people ride in automobiles with complete confidence in their mechanism. They worry not at all about the engine; reserving their anxiety for the unverified assertions of their Congressman, for the economic system, for the treachery of man in fields where a forced morality does not exist.

"If we are to escape descent into darkness," he declared, "the scientist must join forces with other intellectual leaders, because on the advances in the educational, social, and political fields, does the advance of our science depend."

CATTLE PATERNITY

BLOOD tests can be used to settle paternity questions among cattle, Dr. Lloyd C. Ferguson, of the University of Wisconsin, recently reported. Procedure, however, is not the same as in human cases. Human paternity is decided on the basis of blood types, such as are used in "matching" blood for transfusions. In cattle, the things used are antigens—definite chemical entities in the blood that react in the presence of one particular substance. Cattle blood has been shown to possess something over 20 such antigens, each dependent on a single hereditary character or gene.

WEATHER

Automatic Radio Weather Reporter Aids Study

AUTOMATIC weather observing stations, untouched by human hands for months at a time, may soon be scattered around on high mountain peaks or at inaccessible sea locations so that Uncle Sam's weathermen can have complete and automatic radio reports on the changing weather, necessary for predictions, says *Science Service*.

An automatic radio weather reporter, developed by two National Bureau of Standards radio engineers, Harry Diamond and Wilbur S. Hinman, Jr., with the co-operation of the Naval Bureau of Aeronautics, has undergone a successful two-months test at Naval Air Station at Anacostia.

Radio messages that it sends out at predetermined intervals tell the barometric pressure, air temperature, relative humidity, wind direction and velocity, rainfall, and other meteorological factors.

Roots are Pumps

Research Shows Capillary Attraction Has Little To Do With Sap Circulation

PHILIP H. SMITH

TOMATO roots, no bigger than a piece of store twine, have a pumping mechanism capable of developing pressures of 90 pounds per square inch.

This is one of the recent findings of science and it may help to explain the phenomenon of sap rise which has puzzled scientists for centuries.

If and when you studied botany, your professor probably gave you the "cohesion" theory to explain the movement of fluid in plants and trees. This theory recognizes the enormous pull generated by evaporation at leaf surfaces and the fact that water has great tensile strength in capillary tubes. It seemed to be the best theory available and even now it isn't voided by the revelation of root-pressure, but it falls short of explaining the sudden uprush of sap when there are no leaves to transpire, or how fluid can be lifted as high as 350 feet, as it must in the tallest trees.

The reality of root-pressure was confirmed at the Rockefeller Institute for Medical Research as a sort of scientific by-product. Dr. Philip White, of the Department of Animal and Plant Pathology, was trying to find out how viruses are carried around in a plant which has no circulatory system such as is found in man. He turned to the vitalistic root-pressure theory which had been advanced about 200 years ago by the Englishman, Stephen Hales, the extraordinary clergyman who first measured blood-pressure in animals, and invented the first gas mask and the first ventilating system for ships. Hales' theory had been abandoned in favor of more mechanistic theories. He had worked with decapitated, dying roots and the slight pressure obtained was unconvincing.

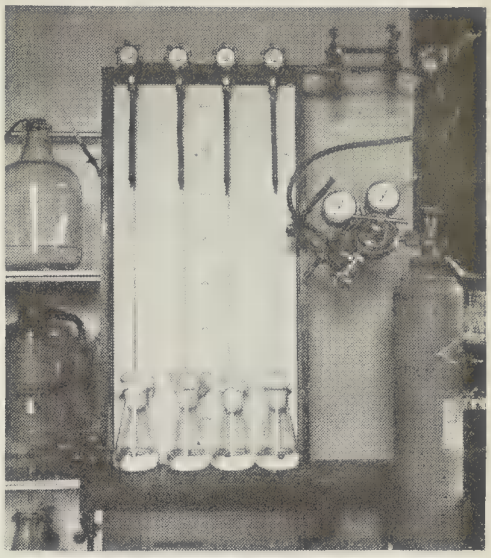
To carry out his experiments, Dr. White built upon a previous achievement—that of being able to keep excised roots alive in nutrient. Roots can be made to live indefinitely, floating in a beaker, provided they are supplied with everything they get normally from soil plus what they would get from the air if they had the benefit of leaves—a sort of super-hydroponics.

Just such a delicate root strand, kept alive for several years under artificial conditions, was selected for the experiment. Its base was inserted in a glass tube, or capillary manometer, and anchored firmly in place with a rubber collar, to give a set-up in which part of the root was in the tube and part protruding into the nutrient. The root then secreted water into the tube, building up pressure. When the pressure mounted it became necessary to add a metal clamp lest the rubber be ruptured, but at no time could the root itself be crushed.

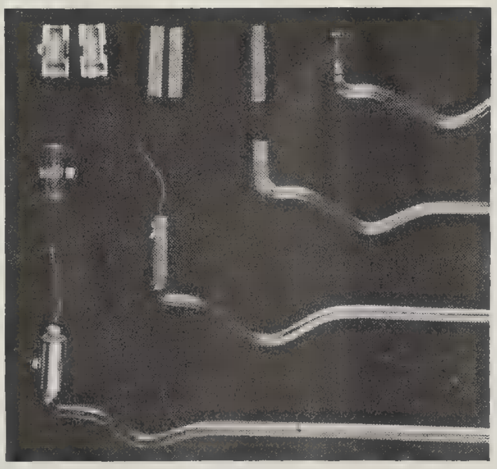
When first attempted, the surprising pressure lifted the water to a height necessitating the running of the tube up a stairway to a second floor, and even that wasn't enough. When mercury was substituated for water in the tube, the pumping was maintained with irresistible force. Finally, to keep the experiment within bounds, compressed air was applied at the opposite end of the tube and the root forced to pump against it, which it did readily.

It was observed, also, that whether pumping against pressure or not, the rate of secretion displayed a diurnal rhythm.

Ninety pounds pressure represents the limit reached by experiments rather than the limit of root capacity. When 90 pounds was attained, the root was still pumping, and Dr. White is of the opinion that pressure cannot be less than 150 pounds per square inch, and is probably more.



Root pressure apparatus showing air tank for back-pressure



Manometer assembly used in the study of plant root pressures

One now wonders what starts the rise of sap in the spring. Observing nature, one would guess temperature or light, or both acting together. However, subsequent experiments, conducted elsewhere, under controlled conditions of temperature and light, failed either to stop or start the pumping, or to alter the diurnal rhythm. Nature holds her secret close. One might wonder, too, what difference there is in the constituents of the nutrient taken in by the root and the fluid secreted by it. Are the nutritional elements removed, or are some food values passed along to nourish the rest of the plant which isn't there? The quantities available for analysis are so minute that special methods will have to be devised for such determination.

Scientists do have an interest in trying to determine whether there is a diurnal rhythm in respiration rate corresponding to the rhythm of secretion. If this could be established, it might reveal the mechanism which supplies the energy for the pumping.

The nature of this work warrants the layman's critical "So what?" Are there immediate, practical results? The reply must be "No." We are simply further along in the understanding of plant physiology. Add other facts yet unknown, to widen the horizon, and sometime the practical value may emerge in the most unforeseen manner as it has in innumerable cases.

Business and Changing Climates

Are Slow Climatic Changes the Basic, Underlying Cause of Economic Cycles?

CLARENCE A. MILLS, M.D., Ph.D.
Professor of Experimental Medicine at the University of Cincinnati

MAN is far from a uniform being of standard proportions and capacity for accomplishment—he differs widely from place to place and from time to time. Years of investigation have revealed that the primary basis of these variations is the ease or difficulty of heat loss from the body.

All bodily and mental activities or functions are intimately bound up with the combustion of foodstuffs in the cells and the liberation of heat and energy. Every activity in the body is accompanied by and dependent on this combustion and heat production. Growth and development, ability to resist infections, as well as muscular and mental activity, are based on this internal burning of food materials. Hence the factors that determine the combustion rate become dominant forces controlling the general activity and energy level of the individual.

With man—and other warm-blooded animals—the body temperature is maintained at a constant level, usually above that of the surrounding environment. So long as life processes go on, heat must be dissipated to the surroundings, else fever and death ensue. Higher external temperatures, making heat loss more difficult, result in a suppression of internal combustion and a lowered level of vitality and general body function. Growth and rate of development are slowed, resistance to infection falls, and energy available for action is sharply curtailed. When body heat loss is accelerated by lower outside temperatures, just the reverse occurs. It is in the temperate regions of the earth, where body heat can easily be dissipated, that children are heaviest at birth, grow most rapidly, enter puberty earliest, and reach greatest adult size. There energy available for action is highest and people are irresistibly driven into a restless activity that attacks difficult problems with a high degree of success.

In polar cold, however, body heat loss becomes too free, and, instead of human vitality and energy there rising highest, it tends to fall, as the body is faced with the necessity of using too much of its combustion activity merely for keeping warm. The exhaustion effect of prolonged cold is seen also in the temperate regions during late winter, when the death and sickness rates rise, and all other indices of general vitality fall.

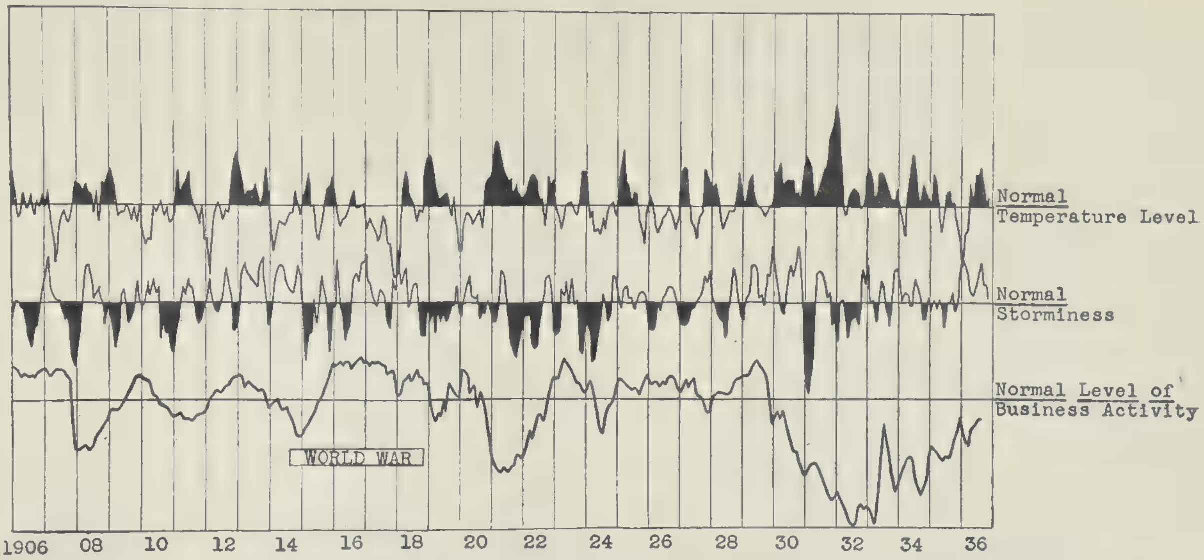
Man, then, responds very definitely in a great variety of ways to the ease with which he loses his body heat. The temperate regions of the earth are in general best adapted for his maximum activity; tropical warmth subdues his functions, while polar cold exhausts and benumbs. This is a relatively new concept of the dynamics of human existence and of the part climate and rate of body heat loss play in life. Let us now see just what this concept means for mankind over the earth.

THE tropical lethargy and listlessness, carefree existence, together with retarded growth rate and body development, result directly from the difficulty people there experience in getting rid of the heat production that goes with a higher level of bodily activity. In the coolness of the temperate zone existence is on a faster, more energetic plane. While infections account for most of the deaths among

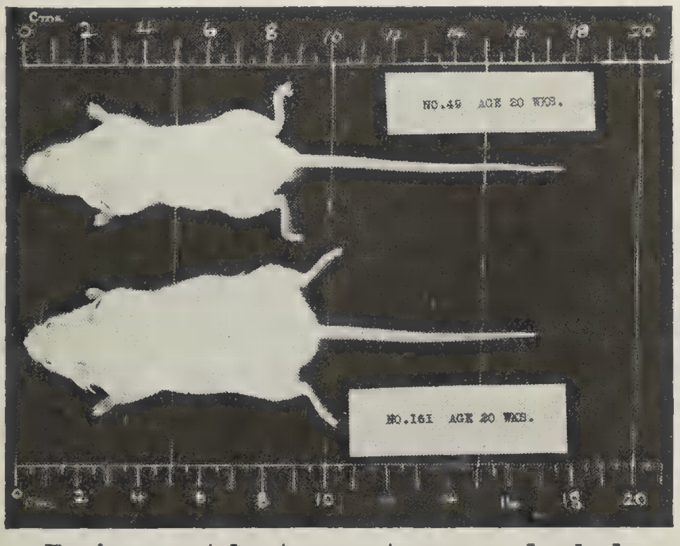
Climatic stimulation over the earth. Index numbers represent intensity of the climatic drive

tropical natives of low vitality, in the energizing temperate climates it is body breakdown from the strain of a fast pace of life that kills the greatest number. Vascular sclerosis, heart failure, diabetes, pernicious anemia, nervous and mental breakdown—these are the signs of stress that are mounting as causes of disability and death in the regions of most energizing climate.

It has ever been the people of cooler lands who have ruled over and exploited the less fortunate ones living under depressing, moist warmth. In wars between nations the same energy gradient has also been a determining factor in the final outcome, for rarely can a low-energy people withstand armed forces full of vigor and determination.



Weather stimulation and business activity (industrial area of the United States). Upper curve: Deviations from normal temperature. Middle: Deviations from normal storminess or temperature variation. Bottom: The fluctuations of business activity



Environmental temperatures and body growth. Smaller mouse represents average size of a large group raised in tropical moist heat (artificial), while those raised under identical conditions except in a cold atmosphere are represented by the lower one of large, robust form. But the ones raised in warmth live longer, though less actively

Regional differences in energy level have been of untold importance throughout the course of history, but there have also existed differences on a time base that have altered the destiny of individuals and whole population masses. The most common time change in energy level is the one that man undergoes as the seasons of each year pass. Energy in temperate regions rises highest through the fall and winter months and subsides to its lowest level in summer heat. Man actually uses less oxygen and has a lower blood pressure in summer heat than he has in winter cold.

Unexpected and unpredicted changes in this climate stimulation, however, bring disastrous upsets in human plans, and with these irregular changes in earth temperatures go changes in human energy level and desire or ability to accomplish.

Correlation of such temperature changes with business activity, back through the past 65 years of weather bureau records, shows remarkably high coincidence of business recessions with the periods of elevated temperatures, and of business booms during prolonged periods of normal or unseasonably low temperatures.

This basic dominance of all human function, and especially of economic activity, by the climatic drive, as body heat loss becomes easier or more difficult of accomplishment, deserves close attention and further study. With the rising energy tide of low temperature periods, business activity expands. At the same time the signs of bodily stress increase and death and sickness rates rise. In the periods of ebbing energy general health improves as business activity recedes to lower levels.

It has been man's failure to recognize this dominance of environmental stimulation that has made impossible a solution of the basic cause of economic cycles. Moreover, the irregularity of their timing has rendered difficult the perfection of plans for meeting the changes as they come.

Fluctuations in the climatic drive, aside from the seasonal and irregular ones of short duration, have left their imprint on the history of nations back through the centuries. The past two centuries of continuous temperature records yield an enlightening picture of the workings of this drive. Outbursts of national expansion, as well as bloody revolutions for greater freedom of individual action, have shown an uncanny tendency to come during years of subnormal mean temperatures—years of the cold, stormy weather that drives men to greater activity.

Long undulations in earth temperatures have taken place and will undoubtedly continue in the future. Longest and greatest of these changes are represented by the glacial epochs and the intervening ages when tropical warmth spread well outward toward the poles. We are only perhaps 20,000 years away from the coldest part of the last glacial epoch, with a likelihood of generally rising temperatures for ten times that number of years to come. The rise in temperatures has not been steady, however, but has come in 2000-year waves. The most recent high point came with the warmth of the Middle Ages (800-1000 A.D.), while the subsequent low point occurred about the middle of the 19th Century. After 1850, world temperatures rose slowly and irregularly for several decades, but since 1920 this rise has become more emphatic. In 1932 the bodies of Vikings were being unearthed in

excavations in Greenland after having been solidly frozen-in for almost 1000 years. And with this recent warming-up has come a sharp turn back toward despotic forms of government all over the earth. Man has felt weaker.

With the cold of the last century came a marked increase in world population and such an abundance of energy and inventive genius as had never before been witnessed in human history. Since 1920, however, population increase in many of the most energetic countries has shown signs of tapering off, with statesmen of several countries worrying about the possibility of an actual decline in numbers.

We seem, then, recently to have passed a crest in human affairs and to be headed for a considerable period of recession. The improvement in stature and trend toward earlier maturity, that has been in evidence during the past century, will no doubt be reversed shortly, for animal studies have clearly shown that these basic characteristics are closely linked to the ease or difficulty of body heat dissipation.

What shall we do about it all?

Disastrous fluctuations in business activity might be robbed of their evils if we could predict the timing of the energy tides in man that seem responsible for the economic swings. If the irregular fluctuations in energy and trade were as predictable as are the seasonal ones, we would be much less disturbed by them and be more inclined to take them in our stride, for panic arises from fear of the unknown. In the individual phase of weather dominance, however, much can be done to relieve us from the undesirable aspects of such influence. Through newer methods of air conditioning and control of indoor environments, we can to a considerable degree alter the effects of outside weather. People in the tropics can raise their energy level and bodily vigor almost at will through indoor cooling to allow ready dissipation of body heat. So also can the physical and mental let-down of mid-summer in temperate regions be eliminated by proper cooling, although it is a question whether it is wise to forego this period of lessened effort when the body relaxes and recuperates for the strenuous winter months to come.

Much remains to be discovered in this matter of weather dominance over man. Humanity really need not stumble blindly through the centuries, engaged in stupidly fighting deep currents of change which are based on forces whose magnitude dwarfs to insignificance man's puny efforts. Is it expecting too much to hope that man will some day arrive at intelligent and understanding co-operation with these outside forces, instead of putting up a futile resistance to the changes they bring?

• • •

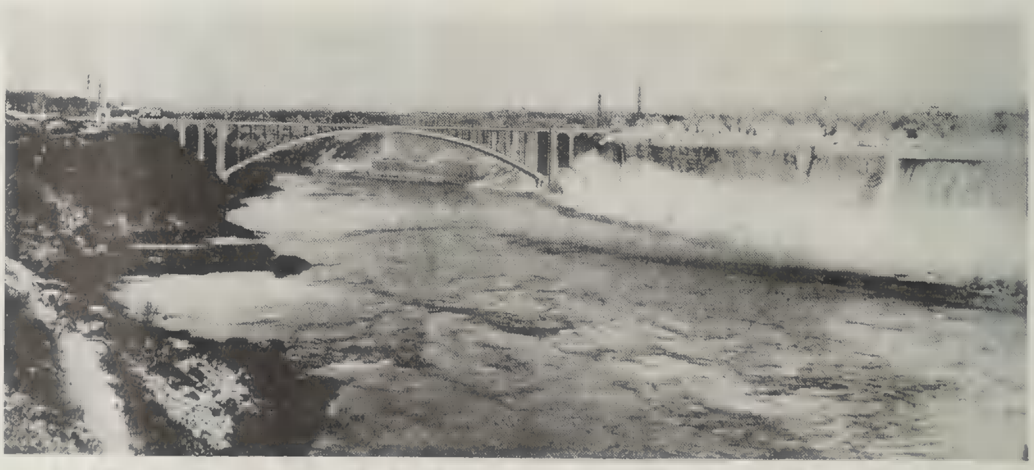
TURKEY STEAKS

FROM the United States Department of Agriculture comes word of popular acceptance of turkey steaks. These steaks are small pieces of turkey meat and housewives can buy them wherever turkey is sold by the piece. They are usually cut from the breast, ½ to one inch thick.

NIAGARA BRIDGE

Structure Over Gorge Safe From Ice Jams

ALMOST directly on the site of the famous Falls View Bridge at Niagara Falls, which was destroyed by an ice jam in 1938, a new bridge was started in June. This new $4,000,000 project will have a main arch span of 950 feet across Niagara Gorge at a point about 2000 feet below the American Falls. It will be the longest bridge of its type in America, the next longest being the Hendrick Hudson Bridge across the Harlem River in New York City. It will have one graceful structural arc across the Gorge and will have no superstructure other than the railings. There will be a wide promenade on the southern edge of the double roadway, giving a full view of both the American and Horseshoe Falls. Traffic will be carried by two 22-foot roadways separated by a mall. Of particular importance is the fact that the foundations for the new structure, in the face of the Gorge cliffs, will be high above any possible ice-jam of the future.



Architect's drawing on photo shows how new Niagara Bridge will appear

CARBON IN CEMENT

Colloidal Carbon as a Grinding Aid in Portland Cement Manufacture

COLLOIDAL carbon, commonly known as carbon black, is an effective grinding aid in the manufacture of Portland cement, according to the results of research carried out by the Columbian Carbon Company's Industrial Fellowship at Mellon Institute, Pittsburgh.

The report of this investigation discloses that a carbon dosage as low as 0.32 percent on the clinker increases the fineness of the cement by 30 percent when the time of grinding is constant, and that the same carbon dosage decreases the grinding time by 28 percent when the grinding is to run constant fineness. With a 1 percent carbon dosage, these improvements become 50 percent and 34 percent, respectively. In terms of power saving and increased output these results are of practical significance. The cements prepared with carbon present as a grinding aid, compared to the controls, showed improved strength properties in tensile and compression tests on mortars. These benefits are attributed in the main to the increased fineness of the cement, although there is evidence that the carbon, per se, is contributory. The use of carbon in dosages up to 1 percent does not alter appreciably such standard properties of Portland cement as consistency, setting time, and

soundness, color excepted, and has no noticeable effect on the resistance of cement mortars to freezing and thawing treatment.

PLYWOOD PANELS

Large Size, Seamless, Easy to Erect

Composite plywood panels in room sizes up to eight feet by 20 feet and faced with fabric have been announced by the Speedwall Company. The giant size of these panels eliminates joints. Ordinarily, one board makes a room wall, while

One-piece panel

four of them make a whole room. Thus this Jumbo Speedwall, as it is called, saves erection time, and eliminates joint making on the job and the possibility of the development of cracks later on.

This Jumbo Speedwall is made up of standard grade, water-resistant, Douglas fir plywood panels, hot-press "welded" together with synthetic resin glues. Surfaces to be decorated are sealed and "dressed" with a strong woven fabric, such as is often applied by fine decorators over many different types of surfaces. The special adhesive with which this fabric is applied also provides fire resistance and a moisture barrier for the wall when it is used.

PLATINUM

Metal Leaf Used for Decorating Building Entrance

The first application of platinum leaf for building decoration was completed recently on the outer vestibule ceiling of the 67 Wall Street Building, in New York City.

Platinum leaf—latest product of the ancient art of gold beating—is beaten down to a thickness which requires a stack of 250,000 leaves to measure an inch in height. Yet, when applied to a surface, the leaf provides a metallic effect with all the rich color and beauty of platinum. The metallic leaf was selected for the entrance because of its brightness, tarnish resistance, and freedom from discoloration by atmospheric conditions.

Platinum leaf has been available for several years for outdoor signs, interior decoration, bookbinding, and many other decorative uses.

QUICK-FREEZE

Machine For Home Freezes Foods

America's first sub-zero locker box for the home has been named Deep-Freeze. It is being built in one-barrel and two-barrel capacities and incorporates certain innovations in refrigeration.

Conventional refrigerators pull against a vacuum but the Deep-Freeze unit actually operates on the pressure side. Tests have shown, it is claimed, that the Deep-Freeze unit requires considerably less current to produce zero cold than does conventional equipment.

The cooling element is unique. It consists of a double wall cylinder of heavy steel which serves both as the food box and as the cooling element. Freon refrigerant is circulated in the space between the cylinder walls; hence the entire usable interior space is surrounded by a refrigerant.

This new Deep-Freeze food locker was developed by W. L. Morrison. The one barrel capacity will be more generally used by urban families while the two barrel capacity might be used by farmers to provide long-term cold-storage facilities for meat and other fresh foods, including vegetables. Sportsmen might use it for quick freezing of fish and other game.

Quick-freezer for the home

CELLOPHANE CEMENT

A new Cellophane cement adaptable to food packaging has been placed on the market by Carmen Products. It is described as transparent, tasteless, and odorless, moisture-proof, and resistant to acids and alkalis.

RUBBER ROAD ROLLERS

The ponderous iron road roller with its clanking, barrel-like rollers, is being displaced in some types of service by vehicles equipped with pneumatic rubber tires. Use of the tires for road rolling has proved the best method of

Multiple pneumatic tires replace the iron barrel of the steam roller

obtaining the equivalent action of heavy traffic compaction on road mix and rock asphalt surfaces, tests have shown. Developed by The B. F. Goodrich Company, the new tires are mounted in series with as many as nine or more to a single vehicle.

TRENCH MORTARS

And Shells Made From Standard Steel Tubing

STANDARD seamless steel tubing can now be used to make trench mortars for the United States Army, according to Captain Daniel J. Martin, writing in a recent issue of *Army Ordnance*.

Trench mortars are light weapons originally intended to be used by infantry to blast the enemy's trenches. They have been so improved that they have become actually light artillery—very effective for blasting out enemy machine-gun positions. Of the two types used, the 60-mm mortar weighs but 39 pounds, while the 81-mm mortar weighs, assembled, 134 pounds. This latter mortar may be carried, disassembled, by three men.

Since trench mortars are smooth-bore weapons and the powder charge is relatively small, Captain Martin explains that both the weapon and the shells it fires may be made of standard tubing. From this it is obvious that manufacture of adequate numbers of these weapons can be attained rapidly and easily.

CHICKEN PLUCKER

Machine Does Work Ten Times Faster

PLUCKING the family chicken—or the game bird from your autumn hunt—will cease to be a burden if you have a new machine recently put on the market as a commercial

Above: **Three-unit machine for removing chicken feathers.** *Below:* **Making the feathers fly**

product. However, since it's designed for mass production, you probably still will find that the old hand method is more economical in the home.

Expert hand pickers in the poultry market can pluck about 35 or 40 birds an hour. The machine will handle about 250 or 300—with some limitations. Tail and wing feathers require manual attention. But aside from that the machine will make the feathers fly. Actual results in the Schulte Poultry Company in Cleveland largely have confirmed the predictions of the manufacturers that the equipment will revolutionize the industry.

Essentially the machine consists of one or more metal drums, each about 2½ feet in diameter. Each drum is bristled with rubber tube fingers, thus in effect becoming a cylindrical rubber brush. As this revolves rapidly it literally brushes out the feathers.

These flying wet feathers naturally are corrosive to many metals. Further, they tend to stick to the machine as they dry. Because of the ease with which it can be cleaned, as well as its resistance to corrosion, the machine is made of Monel. It is manufactured by Mueller Metal Products.—*INCO.*

NON-SKID

Abrasive is Cast Into Metal Stair Treads

SLIP-PROOF stairway treads, which incorporate an abrasive material penetrating the entire thickness of the plate, are a development of the National Bronze and Aluminum Foundry Company. This abrasive, which is called Ten-Lox, is cast in the metal in molten form to insure a perfect bond around each particle of the material. These stairway plates are cast in any size or thickness and are easily installed on existing surfaces through the use of countersunk screws, bolts, or specially prepared mastics.

Ten-Lox slip-proof stair treads and floor tile are impervious to the action of water, oil, and grease. They can be furnished as cast, sand blasted, scratch brushed, or polished, with or without nosing.

TIMBER PROTECTION

Impregnation of Timber With Arsenic Salts, New Swedish Method

MANY attempts have been made to find suitable means of protecting timber against rot and insects. Painting is, of course, the most common but, being only a surface preparation, it does not prevent the body of the timber from taking up moisture, and therefore rot gradually appears even in painted wood.

The effective components of a new Swedish impregnation method are certain arsenic compounds. The method has been developed by the Boliden Mining Company, in Stockholm, which obtains large quantities of arsenic as a by-product in the smelting of copper ore from its mines in northern Sweden.

The impregnation liquid used consists of a solution of various salts, including arsenic. After these salts have entered the timber, a chemical process takes place, with the co-operation of certain easily oxidized substances in the wood itself. The final result of this chemical process is the production of zinc arsenate and chromic arsenate, which become inseparably fixed in the wood, and constitute the effective elements against attacks of decay or insects.

Arsenic-impregnated timber is

said to retain its mechanical qualities. It takes on a soft green color with a slight shade of brown, which is sufficiently strong to render painting unnecessary if the timber is used in buildings. Another advantage is that the timber does not catch fire as easily, and burns less quickly than unimpregnated boards, thus contributing to damage reduction in case of fire.

The new method is said to compare very favorably in cost with other methods. In the Scandinavian countries, arsenic-impregnated timber at present is being used increasingly for various kinds of out-door purposes, including quay and other under-water constructions. Twelve impregnation plants in various parts of Sweden are employing the method, in addition to some in Norway and Denmark.—*Holger Lundbergh.*

PIPE PROTECTION

Oil Pipes Covered with Cellulose Sheet

Experiments have been conducted in the Texas oil fields for more than six years by a major pipe-line company in an effort to find a protective coating material that would be physically and economically satisfactory for use on oil lines. From the many materials tested, there has emerged one shield of considerable promise: Pyralin sheeting.

In one test case, clear, transparent Pyralin .005 of an inch thick was used and in the other, black Pyralin .008 of an inch thick. A coat of hot asphalt was applied to a six-inch diameter pipe which was then wrapped with the Pyralin shield. The line was replaced in soil known to be highly corrosive and inspected intermittently over a period of three years.

Final inspection of the two sections showed that both the clear and the black Pyralin had remained free from chemical or physical change. Considering that a price differential favored the black material, it was decided to select that color for future work, and to use .01 of an inch thick material as a safeguard against breakage from clods and rocks in the trench bottom.

Pyralin is not appreciably affected when exposed to damp atmospheres or immersed in water, reports *The Du Pont Magazine.* Under normal conditions it will absorb only about 3 percent of its weight. In addition, it is only slightly affected by weak acids and weak alkalies. Experiments show that it remains smooth and hard when underground; that when earth surrounding the pipe contracts due to change in temperature, it slips away, leaving the wrapping unharmed. The material has the required rigidity and yet is pliable enough to permit easy application.

To obtain a tight fit around obstacles such as collars and girth welds, the sheets are first softened in a liquid solution of one part ethyl acetate, three parts alcohol, and four parts water. The Pyralin expands, when softened, but upon drying shrinks a greater amount, making possible a tight form fit on sections of irregular shape.

HEREDITY RULES

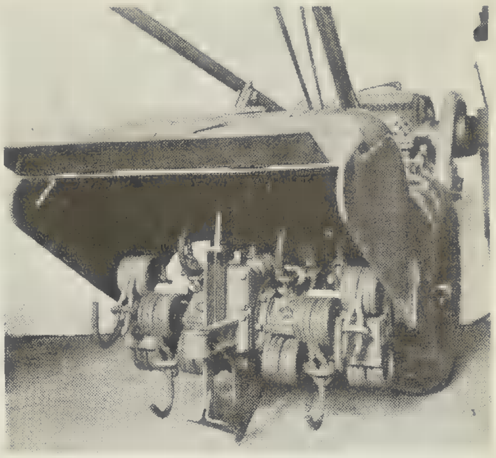
Despite Science's Attempts To Change a Fly

Fifteen years ago a normal fruit fly of the species Drosophila was mated to a female with degenerate wings. From their descendants a similar pair were chosen and mated, the male normal in every respect, the female with vestigial wings. This procedure has been repeated for 300 generations, the equivalent of 9000 years of human life, yet today the genes that produce normal wings in this fly are still functioning, stubbornly refusing to be bred out of existence or changed in their action.—*The Industrial Bulletin* of Arthur D. Little, Inc.

MOTORIZED TILLER

Machine Shreds Soil in Seed Bed Preparation

A new motorized garden tiller, which is steered by handles like an ordinary plow but which is completely motorized, is the product of the Ariens Company. Ariens Tillers are used by truck gardeners, greenhouse men, city parks, nurseries, and the like, for they are ideally suited for these applications as well as for small farms.



Left: **Shredding garden soil with the motorized tiller.** *Above:* **Rotating tines that do the work**

A particular feature of this tiller is the group of rotating, sharply pointed tines under the hood at the rear of the machine. These tines literally tear the soil to shreds, thus making it unnecessary to plow and then to disk and perhaps to harrow a seed bed being prepared. The machine operates equally well in tall weeds which it rips up by the roots. It is particularly adaptable to the job of tilling soil between shrubs or in other restricted or confined spaces.

GLOWING CARPETS

Carpet Fluoresces; Lamp Activates It

Coincidentally, there comes to our desk news of two complementary developments. The first concerns a new "magic carpet" which glows in the dark under the invisible "light" from ultra-violet ray lamps. The other concerns development of a lamp for activating such carpets, making them glow, in such locations as the aisles of darkened theaters.

The new carpet was announced by H. E. Millson of the Calco Chemical Division of the American Cyanamid Company. He explains that the carpet is dyed with special dyes which appear quite ordinary in daylight but glow softly with various colors under invisible ultra-violet rays. Hence, it will be of value in providing an extra safety feature in theaters.

The Continental Lithograph Corporation announces the other

development — new Conti - Glo Black Lights which were designed specifically for this use. Formerly black light equipment gave spotty results whereas the beam pattern of the new one is very long, narrow, and exceedingly sharp in cut-off at the edges.

DRINKING WATER

Need For Better Water Pipe Inspections

RESIDENTS of Joliet, Illinois, a few months ago found their drinking water strangely flavored with beer and soda-water flavors. The reason was a cross connection between city water and a private supply in two breweries and two soft-drink bottling places which permitted back-flow into the city mains.

Reporting this occurence to the trade journal, *Plumbing and Heating Business,* A. R. McGonegal, formerly plumbing inspector for the District of Columbia, points out that "poisonous solutions such as acid copper-cleaning compounds might have been drawn into the mains by a drop in pressure just as easily as beer."

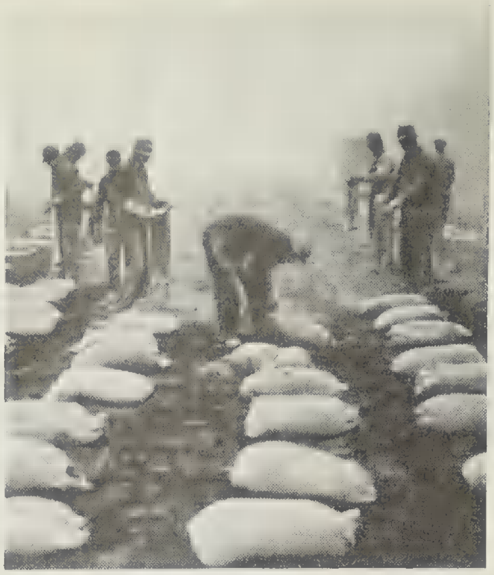
Renovation of water piping in industrial plants all over the country is a health necessity, according to recent reports from public health engineers. Their reports refer to conditions during normal times but the situation probably needs attention more urgently than ever, now that industrial production is being speeded up for national defense, with consequent extra loads on plumbing and piping.

FEEDER ROADS

Surfaced with Cement and Soil Mixture

MOTORING around the country, you soon may be riding on a "dirt" road made with cement! Already, in 29 different states, sections of this new type of road have been installed, using a method of construction which engineers thought impossible only a few years ago, according to James Stokley of *Science Service.* The new method is being used on feeder sections of roads where the $20,000 to $40,000 per mile for concrete construction is not justified.

For years, specifications for making concrete had prohibited use of material containing more than 5 percent of dirt. However, some experiments in South Carolina in 1933 and 1934 indicated that under some conditions it might work. Under the direction of Frank T. Sheets, then director of the development department of the Portland Cement Association, and Miles D. Catton, studies were conducted and formulas and tables were developed to guide future builders.



Above: **Spreading cement for resurfacing a dirt road.** *Below:* **Cutting the cement into the dirt**

In building a soil-cement road the first step is to take samples of the soil and test them. These tests show the proportions of cement and water to be used. Road work begins with a scarification of the old road to a depth of about six inches with rake-like devices hauled by a tractor. A disk harrow then pulverizes the surface. Portland cement in pre-determined amounts is then spread over the road and this is cut into the loose surface by disking and with gang plows drawn by tractors. Water is then added under pressure in carefully controlled amounts, and harrows, plows or cultivators again go to work. The surface is then packed down, graded, and rolled. After slow drying for about a week, the road is opened to traffic, though about a month is required for the road to "season." Sometimes a thin asphalt layer can be applied to give the proper riding surface, though this is not necessary as a protection.

FLOWER POISON

Cut Flowers Keep Best In Absence of Fruit

BY rule of thumb, florists have thought for years that cut flowers would keep better at a refrigerator temperature of 50 degrees. Actually, they keep better at a near zero temperature, though florists who stored cut flowers at that temperature usually found that the flowers would not keep. The Department of Agriculture has found the "nigger in the wood pile."

When the florists stored carnations at just above freezing, it usually happened that storage space was in a warehouse that also contained apples in storage. Ethylene gas is given off by apples in storage and ethylene gas is poisonous to flowers. That is true even when minute quantities of the gas are present as in the case where flowers are stored in a warehouse which formerly contained apples.

GIANT ARC

Quenched by Compressed Air Blast

A POWERFUL blast of air racing six times faster than a tropical hurricane recently blew out an electric arc powerful enough to light for an instant all the lamps in Chicago.

Surging with 150 pounds pressure from a container not much larger than an automobile gas tank, at a speed of 600 miles an hour, the gust of compressed air extinguished an arc of one and one half million kilovolt-amperes in approximately one one-hundred-and-twentieth of a second. Only a slight puff of smoke trailed off as a reminder of the once powerful arc.

Executives and engineers of electric power, industrial, and transportation companies from all over the country witnessed this unique demonstration of a newly developed compressed-air circuit breaker at the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company. L. R. Ludwig, manager of the company's air circuit breaker engineering department, said this test

represented the greatest amount of power ever interrupted by a 15,000-volt commercial breaker operating in air.

One of the functions of a circuit breaker can be likened to a fuse on a power system to open the circuit in case of trouble on the line and prevent its reaching the power house. The other is that of a disconnect, comparable to the wall switch at home, which enables the power engineer to open and close power circuits at will.

Essential parts of the breaker include a tank of compressed air at a pressure of 150 pounds per square inch, valves and pistons to operate the air mechanisms, contacts, and arc chutes or fan-shaped interrupting chambers. All of this mechanism is interlinked mechanically and takes up no more space than a household refrigerator.

The new circuit breaker quenches in a few inches of space an arc that theoretically would have to be pulled out some 40 feet to be extinguished in ordinary air.

WATER - SOLUBLE

New Waxes are First Completely Water Soluble

Two recently-introduced products should be tempting to experimenters interested in testing each new kind of substance in the hope of finding distinctive properties to impart to existing articles. One of these substances, reports *The Industrial Bulletin* of Arthur D. Little, Inc., is physically like petrolatum and the other resembles a wax of 125 degrees melting point, but both have solubility properties that are unique. They are the first waxes completely soluble in water, forming solutions as transparent as water itself. While readily soluble in benzene and toluene, the acetates, and acetone, they are not appreciably soluble in naphtha or other petroleum products, or in turpentine, waxes, or fats. Odor and taste are slight, and preliminary tests on animals indicate that these products are harmless, at least when applied externally.

The waxy or greasy feel suggests slip or lubricating action, for uses where actual greases are not wanted. For these and other applications they can be applied as clear water solutions.

The producers, Carbide and Carbon Chemicals Corporation, suggest the soft form as a plasticizer for casein, gelatine, or glue; in

various binding and film-forming applications; as a lubricant for rubber; as a softener for belt-dressings; and as an ingredient of air-scrubbing liquid, in addition to cosmetic application in creams, lotions, and hair preparations. The hard form has binding properties applicable to films, and its surface activity favors suspension of pigments and lakes. This combination of pigment-holding and binding properties offers possibilities for water-soluble, temporary marking crayons and paints, and even for calcimines, grease-proofings, and dressings. Many other kinds of uses will undoubtedly be discovered by experimentation.

ENAMEL REMOVER

Non-Caustic, Floats off the Surface

AN opaque liquid about the color of cream, and called Metastrip, strips baked enamels, varnishes, lacquers, paints, and even the latest synthetic finishes from all kinds of metals by a simple emulsifying action. This product of Surface Finishing Products Company contains no caustics, yet it floats the finished surface away from the metal in about two minutes or less. If the surface finish remains in the solution, it breaks up into small particles and stays in suspension.

No special equipment is required for using this agent. Metastrip is maintained at a heat of about 190 degrees to 213 degrees, Fahrenheit, and the work is simply immersed in it. When removed in about two minutes, the metal has a clean, bright surface.

Metastrip is made in two strengths, single and double. For average work the single is recommended.

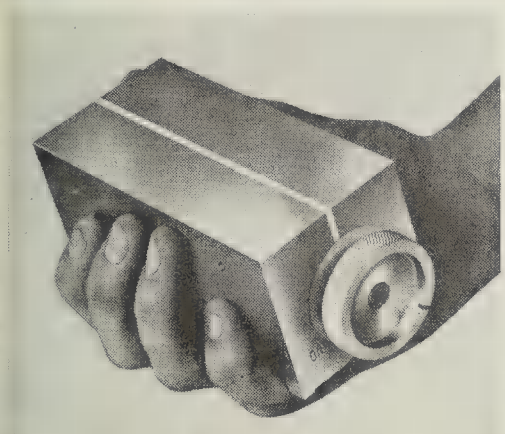
HOLDING TOOL

Magnetic Holder For Small Parts in Production

ADAPTATION of the principle of the magnetic chuck to a new magnetic tool has been made by Brown & Sharpe Manufacturing Company. This tool, which seems merely a block of metal with a knurled wheel at one end, constitutes a holder of very small magnetic parts which would be distorted or marred in some way if held by the usual vise. Iron or steel work wide enough to span the narrow insert in the top of the block can be held firmly on

it for testing, inspection, and hand operation.

The knurled wheel revolves a magnet inside the block. In one position the magnetic flux moves only within the body of the block. When the wheel is turned in the "on" position, the polarity of the



magnetic flux is so changed that one field passes up and over the insert in the top of the block, continuing its circuit through the "work." The opposite field of flux passes downward and through the conductive surface on which the block rests so that the block is held as firmly as though in a vise, and it, in turn, holds the work firmly on top.

CULT SNAKES

Why Cultists Prefer Copperheads to Rattlers

COPPERHEAD snakes are less deadly than rattlesnakes, water moccasins, and coral snakes. This may explain why followers of the Holiness religious cult in Georgia have been able to handle copperheads in their church rites with apparently few fatalities.

The bite of the coral snake is very dangerous because the venom of this reptile attacks the nerve centers. The venom of rattlesnakes, moccasins, and copperheads, on the other hand, destroys red blood cells and breaks down the walls of the blood vessels. Serious as this condition is, it takes a little longer period before it becomes fatal, giving a chance for the victim's recuperative powers and medical aid to overcome the effect of the snake venom.

Copperheads are very dangerous and there are records of deaths from the bite of this snake, but such deaths are not common. The reasons why the copperhead is less dangerous than the rattler are that the copperhead has shorter fangs, less virulent venom, and, because of its smaller size, injects a smaller amount of poison into a bite.

The habits of the copperhead may also have helped to protect those who handled it in religious rites. This snake is very quiet, seldom striking unless very definitely annoyed or attacked.—*Science Service.*

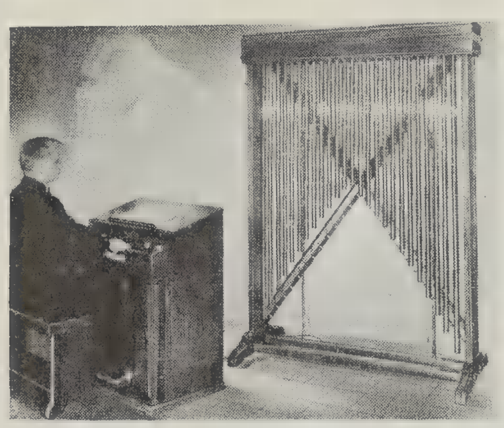
RADIO FIRE-TRUCKS

IF A fire department has no quick means of calling for additional help, or if it is unable to notify the apparatus of an error made in the location of a fire and the trucks have to make an unnecessary run before finding this out, then the department is not utilizing its apparatus with the greatest efficiency. If the department cannot send apparatus back to the station when it is found that they are not needed, or if it cannot shift equipment and men from fire to fire, the department may be said to be operating at lower than its maximum efficiency. Through the increased use of the radio, this condition is being steadily improved. Two-way radio has made possible the operation of a department as a closely co-ordinated, yet flexible, unit, free from confusion and lost motion.—*Fire Engineering.*

CHIME-CARILLON

Gives Impression of Costly Belfry Carillon

WHAT is said to be the world's most accurately tuned carillon is now being produced by the Sundt Engineering Company. This instru-



ment is an amplified, 25-chime, 37-note, keyboard-operated, tubular, chime-carillon. The keyboard is played like that of a piano. Large outdoor speakers mounted in a church belfry give the impression of a large and costly bell carillon.

The Sundt carillon is tuned to

such close accuracy that it eliminates the out-of-tune sound so frequently occurring in outdoor carillons when two or more notes are played together. Special electric pick-ups on each chime pick up the deep sub-octave bell notes which are amplified separately. In this way the range is extended a full octave. Microphones pick up the usual chime note. The two are blended by foot pedals to obtain unusual "distance" effects and variations.

Although the total weight of the Sundt carillon is only 600 pounds, the deepest note it produces equals the tone produced by a bell of 12,500 pounds.

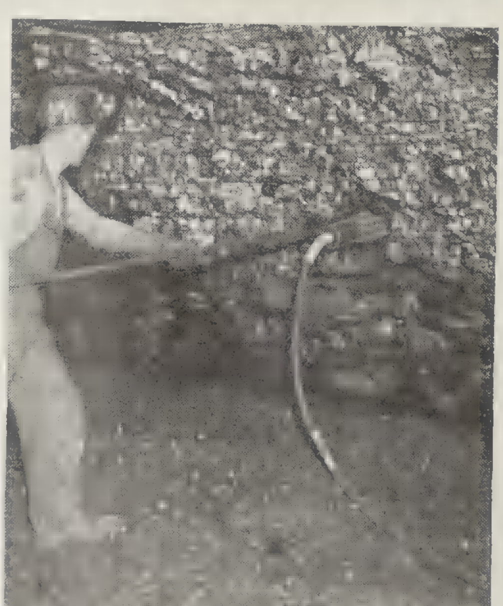
HYDRAULIC

Coal Mining With a Pressure Tube "Explosive"

Hydraulic pressure is now being used in coal mining to take the place of explosives usually used. Results of tests made over a period of about two years have been promising enough to warrant the du Pont Company placing this process on the market in a limited way.

The hydraulic mining process is basically simple. After the usual holes are drilled in the coal face a special tube, closed at the end, is inserted. The protruding end is connected through an electrically driven pump to a storage tank containing a special oil. The pump drives the oil under very high pressure into the tube inserted in the hole, the tube expands under the great pressure, and the coal face is broken down.

In other words, the pressure exerted causes such expansion and resultant enlargement in diameter of the tube that the coal is broken free along its natural parting lines, without explosion, flame, or the evolution of fumes or smoke.



Inserting a hydraulic mining tube in face of a coal vein

Close-up of the mining tube that expands under pressure

The mining tube itself is of rubber with a relatively small hole and a thick wall, and is covered with a steel braid that both protects it and prevents its rupture.

Experimental work on this new method was conducted by the du Pont Company in a number of mining areas. The most extensive tests have been made at the New Monarch Mine of the Consolidated Coal Company at Herrin, Illinois.

OIL

U-V Rays Detect It In Mud From Wells

New aid to rotary drillers in finding oil-bearing formations is the ultra-violet ray. Inventors say it detects instantly minute quantities of oil invisible to the naked eye in drilling muds.

After mud has travelled down through the hollow drill pipe, passing out through the drill, bringing cuttings back to the surface, a beam of ultra-violet rays is focused upon it. The tiny particles of oil, if present, become fluorescent.

WARSHIP SPEED

Italians Test Unfinished Ships

Much has been written in recent years of the success of the Italian Navy in building enormous speed into Italian warships. Almost invariably trials of cruisers and destroyers show speeds several knots higher than those in comparable vessels of other navies. It is to be wondered if these high speeds are all to be explained as may be that of the 10,000-ton cruiser, *Zara*. We

quote the following paragraph from *Engineering* (London) regarding the trials of that ship.

"A photograph from the air of the 10,000-ton cruiser *Zara* on trials showed that she was minus the whole of her main armament, including not only the guns, but the turrets themselves. In such circumstances, it is not difficult to attain remarkable trial speeds, but the assumption is reasonable that another year, at least, would be required before the vessel could be regarded as an efficient fighting unit, fit to take part in any combined naval operations."

COPPER PLATING

Immersion Process

Is Simple, Economical

OFTEN a coating of copper is desired on metal quickly and more economically than is ordinarily obtainable by electro-plating. Use of Cuprodine solves the problem. This is a powdered chemical which is employed in much the same manner as ordinary copper salts but produces a denser, more adherent, and more lustrous coating. The process is particularly adaptable to the job of coating round wire to reduce the wear on drawing dies.

The Cuprodine process is simple. The surface to be copper coated is first pickled and then rinsed. It is then immersed in the Cuprodine solution until the coating is completed, which may require from 10 seconds to two minutes depending upon the nature of the steel or the thickness of the coating desired.

TREES

Personal Histories

Suggested

THE life history of a single tree may not seem particularly important, yet such a history, if complete in many details, would make not only an interesting record for future generations but conceivably might supply scientists of the future with facts regarding tree growth that would be valuable to them.

Professor Ralph G. Unger, of the New York State College of Forestry, at Syracuse University, recently suggested that such personal histories of trees might be made by many persons. Under his plan, the common and scientific names of a tree—perhaps one planted for

shade purposes in a yard—would be recorded: other facts would include the origin of the tree, the date and age when planted, and by whom. Thereafter, an annual record would be kept of the diameter in inches, height in feet, crown spread, disease and insect attacks, any injuries, extent of seed crop, and similar details. These records would be handed down from generation to generation in a family, or from owner to owner.

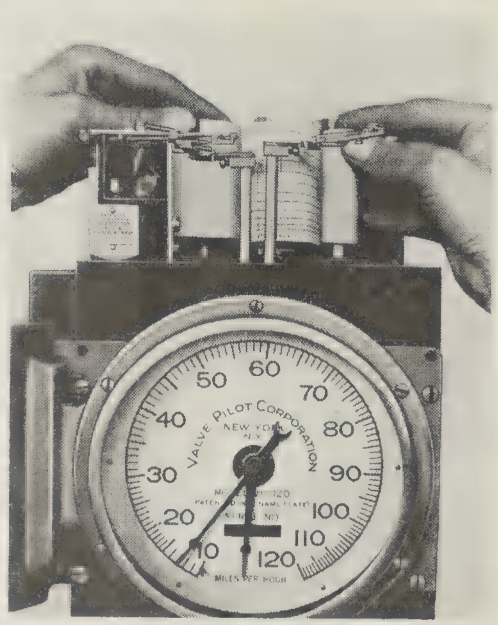
Professor Unger urges adoption of this plan because, as he says, "our historical trees are disappearing rapidly . . . and the young tree of today may become important historically in the future."

LOCOMOTIVE RECORDER

Checks Engineer's Alertness to Signals

To provide railroad officials with a graphic record of their engineers' alertness to running signals, Valve Pilot Corporation of New York City has developed an Automatic Train Signal Recorder.

Where railways are equipped with automatic block signals, a train will stop automatically if it runs past a caution light. By moving the so-called forestalling lever, the engineer forestalls this automatic application of the brakes and then proceeds in accordance with the instructions flashed by the signal. Ordinarily his superiors have no record of this action, but if the locomotive is fitted with an Automatic Train Signal Recorder, a record is made automatically each time the engineer forestalls.



The instrument consists of a pencil attached to the armature of an electromagnet. When the engineman forestalls, a warning whistle in the cab sounds off. The rush of air to the whistle closes an electropneumatic switch which sets up an electric current in the magnet and causes a pencil on the armature to make a mark on a paper tape.

The Automatic Train Signal Recorder is housed in the Loco Valve Pilot instrument which indicates and records speed and cut-off control. From one unit, therefore, there is obtained a record of the engineer's attention to three important operating factors—efficiency, speed, and safety.

FIRE ALARM

Self-Contained Unit Rings a Loud Gong

A DEVICE no larger than the hand and employing mercury as an activating agent conceivably might save many of the 10,000 lives that are annually sacrificed through fires in American homes.

The life-saving invention is an automatic fire alarm, complete in itself, which sounds its warning almost immediately upon the outbreak of any fire in the area which it guards. The alarm functions through the thermostatic action of a tiny mercury switch. When the temperature about it reaches a degree which indicates the presence of fire, the mercury switch sets off a gong of sufficient volume to arouse the household, even from the deepest sleep.

Since the new alarm is so small in size, it can be hung inconspicuously on walls or laid upon dresser or table—and the price has been made sufficiently low that the average family can place several units in danger spots throughout the home without any strain on the budget.

LABORATORY RUBBER

Another, of Superior Quality, Added to List

THE newest of the synthetic rubbers, Chemigum, has just been announced by Goodyear as a result of several years research. A new plant having an initial capacity of 10,000 pounds per day is being installed at Akron.

Chemigum is derived from petroleum through a cracking process, and tires made of it are said to give superior performance to those made of German Buna. In

fact, the manufacturer claims that such tires are equal to those of natural rubber. Like other artificial rubber, however, Chemigum at present costs more than natural crude rubber. Nevertheless, its increased tensile strength; resistance to aging, abrasion, and oils; and the fact that it may be processed more easily than Buna, make it important industrially. It also has possibilities for blending with natural rubber, so that it might help in an emergency to eke out slender supplies of the natural product.

SAPPHIRES

War Cuts Down Supply For Industry

SYNTHETIC sapphires, important for use in jewelled watches and many industrial instruments, are becoming scarce, as we have had to import them from Switzerland, France, and Germany.

These gem stones have been made since 1902 by the Verneuil process which fuses alumina. The globule which is obtained is split and sliced into thousands of tiny jewels. Those used in watches are of small diameter and almost paper thin. The price of these ranges downward to about one and one-half cents each.

TUBULAR LIGHT

Smaller Fluorescent Tubes For Restricted Spaces

WITH fluorescent lamps becoming more popular every day, the need for a small low-wattage lamp of

this type for use in limited space has been filled by the production of one only nine inches long. This new lamp is of six-watt capacity, is available in two colors—daylight and white—and sells for $1.15. It is expected to find applications in illuminating business machines, curved showcases, and airplane cabins, in bed lamps and the like.

YOUR FIREARMS and FISHING TACKLE

Conducted by A. D. RATHBORNE, IV

INTEREST IN FIREARMS *is traditional with American men; fishing tackle is a requisite of one of the world's oldest occupations. Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department which welcomes correspondence from its readers.*

Strange Guns in Strange Places

IN 1855, General William Walker, one of America's most meteoric soldiers of fortune, simultaneously reached the ripe old age of 32 and the shores of Lake Nicaragua, in the country of that name. With his "expeditionary" force of 66 men, he appropriated a boat from The Accessory Transit Company, a Cornelius Vanderbilt-controlled freight and passenger line, captured the key city of Granada, and made himself master of Nicaragua. For five years his star alternately flared and dimmed. It was completely extinguished with his execution in 1860, but the name of William Walker was forever engraved in Nicaragua's history, and elsewhere, as will be seen.

Uprisings, rebellions, punctuated by short periods of quiet, beset the little country until 1927, when President Coolidge's emissary, Colonel Henry L. Stimson, brought peace to the rival parties. Government troops and rebels were both disarmed under the treaty, which provided $10 Nicaraguan money and an honorable discharge to each officer or soldier who surrendered anything that would shoot. The U. S. Marines had charge of this collection of arms, of which there were thousands. They consisted of ancient Spanish brass cannon, modern Thompson sub-machine guns which were in the hands of Nicaraguan rebels before our Marines ever saw them, flintlocks, cap-and-ball revolvers, and modern Springfields. Where all the guns came from, no one knew, but among them were collectors' pieces by the bull-cart load. A request was made that such arms be saved, either for an American museum or for the Nicaraguan National Museum. It was denied and three box-car loads of surrendered arms were destroyed under American supervision.

A long, thin echo of the American soldier of fortune, General William Walker, bounced down the ages, trickled through the destruction of Nicaraguan arms, to reach, in 1940, the ears of Charles Edward Chapel, eminent gun collector and author, in California. Chapel visited a brother gun collector who showed him a Colt Model 1848 Pocket Revolver, sometimes called the "Baby Dragoon" Model. This was a caliber .31, 5-shot, percussion (cap-and-ball) revolver with a standard 4-inch barrel, worth about $25 in good condition, about $37 in what collectors call "fine" condition. As antiques go, it was no show piece, but what attracted Chapel's attention was that, in addition to the usual markings, the barrel was engraved with the name "William Walker."

"My grandfather," said the collector, in response to Chapel's question, "whose name was Walker, carried it in an inside pocket as a personal weapon during the Civil War."

Chapel grinned, asked his friend what he knew of Nicaraguan history.

Courtesy Colt's Patent Firearms Mfg. Co.
"Baby Dragoon"

Under cross-examination the collector broke down, admitted he had bought the gun from a dealer and that the ancestral story was pure hokum. Then Chapel told his friend a bit of the gun's history and tried to buy it, but the collector refused to sell, even though there are plenty on the market like it—like it save for the engraved name, "William Walker."

"How do you happen to know so much about this particular gun?" asked the collector.

Replied Chapel: "I was a lieutenant in the 5th Regiment of Marines, on expeditionary duty in Nicaragua. I saw that engraved Colt at that time. It was I who made the request to save the collecors' pieces, and when it was denied, I was ordered to take my guard detail and the three box-car loads of guns to Managua, where the arms were burned."

Was that 1848 Colt engraved "William Walker" as the would-be conqueror's personal gun? Where was it during the 67 years from the filibuster's death to the surrender of Nicaraguan guns in 1927? How did it escape the supposedly all-consuming fires that destroyed the other surrendered arms at Managua. How did it get into the hands of an American dealer in antique arms? These questions may never be answered, but

they show in part the color and romance of gun collecting. Has anyone else a story about "Strange Guns in Strange Places"?

[Note: Charles Edward Chapel retired from active service as 1st Lieutenant in the U. S. Marines Corps in 1937, after having served in China, Nicaragua, and other points since 1926. His book "Gun Collecting" now has a companion piece, "The Gun Collector's Handbook of Values," both of which are essential to amateur and professional collectors of antique arms. A publisher as well as an author, Chapel's latest production is a second printing, limited to 1000 copies, of Charles Winthrop Sawyer's "Firearms in American History—Vol. 2—The Revolver, 1800-1911." Sawyer, still regarded as the Dean of American arms historians, wrote and published his first edition in 1911. It sold rapidly and is extremely rare today. —*Ed.*]

Behind the Trigger Pull

In the intricate science of firearms manufacture, it's little things that count. Take, for example, 1/600 or 1/700 of a second which elapses from the moment a shotgun hammer is released by trigger pull until the firing pin detonates the percussion cap. Doesn't sound like much, but multiply it by 800,000, the number of tests rounds recently fired by Federal Cartridge Company in a Savage shotgun and you will find that the hammer of that test shotgun was in downward motion a total of 22 minutes, 13 seconds. "So what?" you say, for no average shooter will live long enough to fire 800,000 shells. Why, that's a box of shells a day for 87 years and 245 days!

So, this. When you buy an American-made shotgun, you can be confident the gun will stand up, that it will give you a lifetime of satisfactory service. Neither Savage Arms Corporation, nor any other American arms maker expects Mr. Average Gunner to burn 800,000 shotgun shells, nor do they anticipate the hammers of their guns will be in action 22 minutes and 13 seconds, but they do expect their products to perform satisfactorily. To that end, the arms—rifles, shotguns, handguns—are tested far beyond the potential possibility of their use, and actual firing tests are by no means the only indication of solicitous care in manufacturing processes.

On a recent visit through the Savage plant we passed row after row of assembly work benches, and we noticed that every vise which was holding a gun part was carefully padded to prevent scratching or otherwise damaging the part. We saw hundreds of wheel-equipped racks, built to transport highly polished stocks, shiny gun barrels, or complete guns from one department to another, and every one of these racks was also carefully padded. Particularly fine stocks were protected from mars or dirt by soft flannel bags in which they traveled about the plant until they became a part of a beautiful new gun, and then the gun itself went into a bag for safety and protection until final wrapping and shipment. All too few gunners comprehend the meticulous care their guns receive before coming into their possession, and sad to relate, all too few owners give their arms as good care as they had in the process of manufacture.

Simplification of operating mechanism in modern arms is another of those "little things" which years of scientific study have accomplished. If John Q. Gunner had to manipulate an old flintlock, which contained 22 parts, or a muzzle-loading lock of 15 parts, he'd have something to worry about. Even the breech-loading hammer gun lock has 17 parts, and certain types of high grade hammerless guns contain from seven to 22 working items in the lock. By comparison, the Fox Lock, a Savage Arms product, with its three principal working parts, is simplicity personified. There's the coil spring, the one-piece hammer, of which the firing pin is an integral part, and the sear. That's all.

There are thousands of other examples of scientific advancement in the history of American-made firearms. It's a record to be proud of. The American lover of guns, whether for target or game shooting, is the most fortunate gunner in the world, for he has a limitless line of guns from which to choose. He has, at his command, a corps of manufacturers, research engineers, scientists, and skilled artisans who persistently endeavor to produce better firearms at moderate cost. Best of all, he has, with few minor restrictions, complete freedom of use of his rifles, shotguns, and handguns. So, Mr. John Q. Gunner, when you take your gun afield this fall, just remember that behind the simple action of pulling the trigger lie years of intensive study and research, all to the end that you may better and more thoroughly enjoy your sport.

October Bass

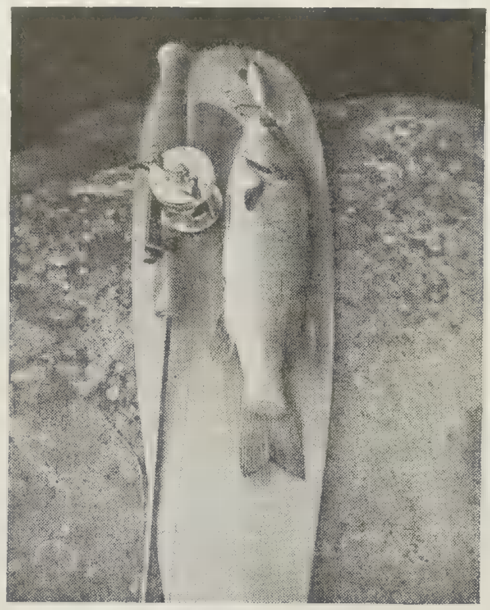
As the prize short-short story, we nominate the motto, "Fish and Feel Fit," adopted by The Associated Fishing Tackle Manufacturers, used extensively by South Bend Bait Company.

When you analyze that slogan, you find it tells all. At this time of year the word "fish" conjures up for salt-water anglers visions of striped bass, weakfish, channel bass, bluefish, and

many others. To the fresh water Waltonian, those four letters bring mental pictures of pike, pickerel, walleyes, black bass, and huskie muskies, all of which have been rejuvenated, imbued with new fight by Autumn's cooling waters.

The second word in the slogan isn't really necessary, but it's euphonic, and it provides the suspense angle in this short-short tale. "Fish, and . . . ." And what? Ah, those two last words, "Feel Fit." They're the ones that settle the suspense, if any, and provide the logical, truthful, satisfactory, hammer-home-the-point climax.

It's difficult for us to imagine how any two-fisted chap could fish and not feel fit, but we claim those two words form a "logical" climax, because any



OCTOBER BASS
Rod by Heddon
Reel and line by South Bend
Plug by Shakespeare
Bass by Ye Editor!

angler knows that one reason he goes fishing is to feel fit. When he accomplishes his purpose, he's proved his point. It's a Q. E. D. The same words comprise a "truthful" climax. When you toss that plug into the muskie's lair, tinged with reflected colors of the Autumn forest, or when the salt spray crisps your face as that striped bass tries to take your tackle from October into November, you forget every worry you ever knew. You *have* to feel fit.

Those two words make a "satisfactory" conclusion to the short-short tale. Most of us like happy endings, and what could be more satisfying than to "Feel Fit"? And if it isn't a "hammer-home-the-point" climax, we never saw one! When you think of the phrase, "Feel Fit," don't you vision a Dempsey in his prime; a 4-times champ, Bobby Jones; a Tilden, aceing through the field; an unstoppable Ty Cobb? And aren't they all sort of rolled into one and a part of you,—when you "Feel Fit"? All this is just another way of saying there are still several good weeks of fishing before we pack away the tackle. If you'd like proof, take another look at that October bass. The picture vividly brings to mind the cool of a fall evening, the graceful flight of the plug, the smashing strike . . . and then, did I Feel Fit!

Butts

ONE of the surest ways to start an argument among a group of surf fishermen is to ask an apparently innocent question regarding the relative merits of spring butts and club or extension butts for surf rods.

Confirmed spring-butt addicts will rise to the bait, claiming that this type, by far the older form in the comparatively young art of surf casting, permits the surfman to gain greater distance. This, they will insist, is due to the spring action which brings out more of the rod power, and hence throws lead farther.

Club-butt adherents will scoff at this theory, holding that this so-called spring action does just the opposite; that it introduces a vibration in the rod which robs the stick of some of its power. Further, they will say that rod power is delivered largely by no more than the top two-thirds of the rod; that if a rod is so constructed that the action extends even as far as the ferrule it will not have the casting qualities of one that is properly proportioned.

One of this country's leading craftsmen in the field of hand-made surf rods, Charlie Maltby, has held forth on this subject for long hours with the writer. When a cast is made with a spring-butt rod, says Charlie, the entire rod, from tip to butt, approaches the form of a slim letter "S" as casting power is applied. Then, as the lead sails seaward, the bend of the butt part of the "S" reacts and causes the tip to vibrate.

Here is a field that offers opportunity for study by some scientifically inclined surfman. Perhaps one angle of approach would be to take slow-motion pictures of a good surf caster using first a spring-butt rod and then a club-butt stick. Analysis of such pictures might reveal facts that would substantiate or disprove theories.—*A.P.P. casting for A.D.R.IV.*

POT-SHOTS
At Things New

STOEGER ARMS CORPORATION's advance information on their 1941 Catalog-Handbook indicates the publication will be most ambitious in Stoeger's long history and will more than ever merit its designation as "The Shooter's Bible." New volume will show 4700 revisions from 1940 edition, as well as replacements for many items made unavailable by changing world conditions. Gun tools and gunsmithing section will be one of most comprehensive ever published; hunting clothes, accessories and book section will be larger; over 100 pages will be devoted to gun parts for American guns; ballistics tables have been thoroughly revised. As virtually all

prices have changed due to rising costs and governmental taxation for national defense, new figures will be shown here for first time. In all, more than 16,000 items, accompanied by 6000 pictures, many in color, are described and priced in the 1941 Stoeger Catalog-Handbook. Frankly, we couldn't get along without our annual copy of "The Shooter's Bible," especially when it's only a dollar, and we're sending in our reservation for a copy right now.

Griffin & Howe, Inc., announce their new "Zero-Rig Telescope Mount," which is a new and radically simple fixed mount for all standard 'scope sights. Once 'scope is set at zero with Griffin & Howe rig, it remains at zero, regardless of how often sight is dis-

mounted. "Zero-Rig" embodies a firmly fitted, square shoulder joint with large, flat-headed screws to hold each bracket arm and 'scope ring in secure contact. By removing these two flush-set screws, 'scope and clamps can be lifted from the fixed base to leave top of the rifle clear for aiming with other sights. We have descriptive folders.

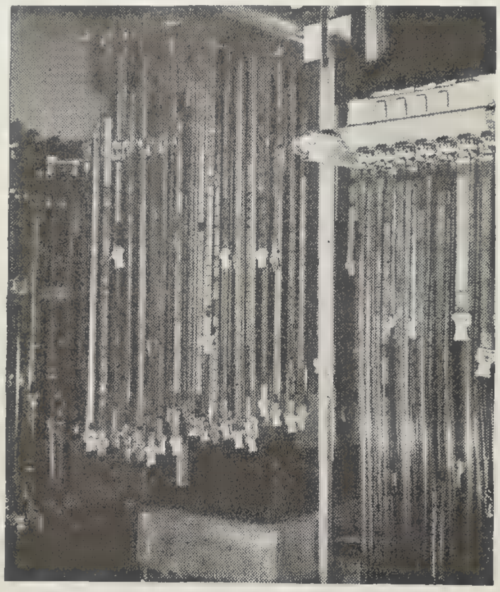
Free Book Lists. We have read and reviewed many interesting and informative books and other publications in the fields of firearms, fishing tackle, natural history. Reviews have appeared in Scientific American's "Our Book Corner" and publications have been mentioned in this department under "Books of the Moment." For your convenience, we have prepared lists of the books thus covered, showing titles, authors, prices, and a line or two of explanation. If you'd like one or more of these compilations, drop us a line and specify your desires. Only cost is a 3-cent stamp for return postage. (Note: Gun book list includes "History of Colt Revolvers," by Haven and Belden, sponsored by Colt's Patent Firearms Manufacturing Company, and hot off the press September first.)

CAMERA ANGLES

Conducted by JACOB DESCHIN, A.R.P.S.

Letting George Do It

"POP" goes another myth—the degeneracy of the photo-finishing plants. There is widely current the time-worn notion, frequently based on fact, that he who seeks the "drug store" finisher deserves what he gets: sluggish work for sluggard workers. But the truth is that there are good photo-finishers and there are bad ones, just as there are good and bad photographers and good and bad anything else.



One corner of the film drying room in the Pavelle Laboratories

In order to obtain a cross-section picture of photo-finishing plants in general, we recently interviewed Leo S. Pavelle, head of Pavelle Laboratories, Inc., an organization offering specialized plus routine service, and Nat Derfler, head of Royaltone, Inc., which serves the routine snapshooter class. In the latter type of finisher, all work in the plant is geared to mass production—prints in seven hours—whereas the former stresses quality rather than the time element. Both types strive to do the best possible work under the conditions imposed.

A few statistics may provide some index to the volume and type of work turned out by the two kinds of finishers. Mr. Pavelle places the yearly average of film rolls processed at his plant at about 150,000, while Mr. Derfler's place develops about 250,000 annually. At Pavelle's, 75 percent of the film is in the 35mm class, while at Royaltone all but a small percentage are the usual amateur sizes other than 35mm. The latter averages 2,500,000 prints a year, 80 percent of the total printing business being contact, 20 percent enlarging. At Pavelle's, the greater percentage of the printing business calls for enlargements, a good portion of the orders being for postcard size enlargements from 35mm negatives.

A visit to the Royaltone plant was an eye-opener, in view of the stories we have been hearing about those awful "drug store" finishers. The 90-gallon temperature-controlled film developing tanks are continually being replenished to keep the solution top-notch; the tank is completely refilled every 16,000 rolls. Rinsing is done in a tank through which fresh water is running continuously. Fixing is done in two successive baths, the first a strong bath, which is thrown away and a new bath made every 4000 rolls, and the second a weaker hypo bath, which is changed every 12,000 rolls. Finally, the film goes through two washes. Drying is done in special rooms equipped with fans to circulate heated air. Printing is not the slapdash affair many persons have been led to believe it is. Each printing machine operator has before him a selection of six different grades of contact paper, from which he selects the proper grade to fit individual negatives. Also, timing is not the same for all negatives but is proportionate to the density of individual negatives. When the print reaches the developed stage it is inspected by the operator there, who may reject a print which has been printed for an insufficient period or on the wrong grade of paper. It is then sent back to the printer for a better print. In other words, the photo-finisher of the Royaltone class does just about what the careful worker would do in his own darkroom at home.

Maintaining standards of the highest order, the Pavelle plant offers a universal service, making prints ranging from contact to photomural dimensions. That the quality of its

Leo S. Pavelle inspecting an exhibiting print in the making

work and the universality of its services has been recognized is shown by the fact that among Pavelle's patrons are departments of the Federal Government, large business concerns, and individual workers all over the world, as well as a mass of amateurs in this country. From developing rolls of films for individual workers the Pavelle services go all the way to the preparation of complete photographic exhibits for large manufacturers of cameras, film, and paper.

One of the Pavelle plant's major activities is the preparation of enlargements intended for exhibition. For this purpose the Exhibition Department was created, in which from 100 to 200 exhibition prints a week

Large trays facilitate handling of prints for exhibition purposes

are turned out, most of them 11" by 14", a good percentage 14" by 17". Mr. Pavelle observes that there is a definite trend toward the latter size as the more popular among exhibitors. The prints are mounted on the regulation 16" by 20" matts required by salons. A wide variety of papers and surfaces are available in this department to match every good negative to the paper best suited to bring out the values and mood of the negative. Most of these prints are selenium or gold-toned. Mr. Pavelle says that the resulting tone is almost imperceptible but is enough to show a real difference, one of the valued results being the realization of better blacks.

One of the features of the Pavelle plant that helps in maintaining quality of service is the Research Group, a skilled staff which has at its disposal complete photographic laboratory testing equipment for testing ever-changing new developments in photography.

"As soon as anything new appears on the market that may be utilized photographically, be it a new light source, a new film, a new paper, or a new developer, it is immediately put through an accurate laboratory as well as practical test," Mr. Pavelle says. "Nothing is taken for granted. If the product proves of merit, its properties are carefully evaluated and it is applied, wherever indicated, to the processes used throughout the Laboratories . . . One outstanding example of the work accomplished is the compilation of complete sensitometric data for all 35mm films and all popular developers."

The Pavelle plant is the last word in modern high-grade equipment, all developing being done in stainless-steel tanks and all machines automatically controlled to process different types of film for the exact times of development, fixation, and washing as well as at a definite rate of agitation in each solution required for each film type. "Ours is perhaps the only still-film laboratory in the world," says Mr. Pavelle, "where daily sensitometric tests determine with scientific accuracy the activity of negative developing solutions. Our negative developers are kept at a constant developing potential by the addition of replenishing solutions in definite ratio dependent on the number of square feet of film that have been developed. Thus all films are invariably developed to a specific gamma in a given period of time."

Paper in Quantity

THE worker who takes advantage of economies in order to keep his photographic costs down, may be interested in the fact that the purchase of printing or enlarging paper in half gross or gross lots will effect a considerable saving. Of course, if only a few prints are made occasionally or if the worker likes to do a lot of experimenting with different papers, this may not be appealing. But those who have settled down to one paper and who do much printing will find that they can save as much as 20 percent or more by purchasing paper in gross lots rather than in packages of a dozen.

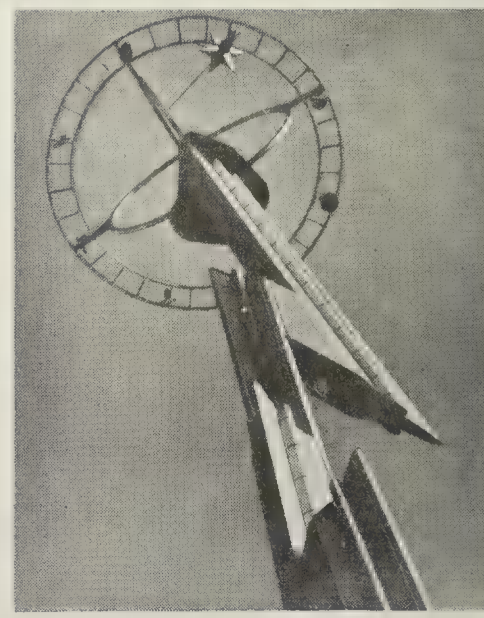
Cooling

A SUMMERTIME developing kink that may possibly be out of date by the time this appears in print (though it frequently happens that temperature runs rather high during some days even in the "cold" seasons of the year) comes to us by way of the picnic basket. A product known as Icit, a sealed can measuring about four by six by one inches and containing a liquid, is being sold for use in cooling the picnic lunch. The can is placed in the lowest ice-cube compartment of the refrigerator the night before the picnic. The next day it is frozen solid and is placed in the center of the picnic lunch. The use of Icit in photography is obvious. The can is placed in the developer tray and, according to the experience of Carlyle Trevelyan, will bring the temperature down to 65 degrees Fah-

renheit. Mr. Trevelyan says that when he used the method one night, he placed the can in the tray at 7 o'clock, when the temperature fell to 65 degrees, and by 12 o'clock the temperature had risen only six degrees. Naturally, the can has to be taken out of the tray when prints are inserted, but this is a negligible inconvenience considering the advantages.

General Electric Contest

EXCELLENT handling of a much photographed subject—the 129-foot stainless-steel symbolic lightning bolt and universe in front of the General Electric Building at the New York World's Fair—brought first prize for George Perry, of New York City, in the first half of the General



First prize, G. E. contest

Electric contest. The award was $100 in cash. A similar prize is offered in the second half of the contest for entries received until October 11.

Held under the auspices of the Photographic Society of America, the judges consisted of Adolf Fassbender, F.R.P.S., Chairman; Robert W. Brown; Morris Germain, A. R. P. S.; Carlyle Trevelyan; and Jacob Deschin, A.R.P.S.

Color Handbook

A "HANDBOOK OF COLOR," containing a complete description of every type and make of color camera, lighting, equipment, chemical, printer, color film, and so on, will be published by Fotoshop, Inc., in the near future. Copies, at 25 cents each, may be reserved by writing to the Color Department of Fotoshop, Inc., 18 East 42nd Street, New York City. The contents will also include laboratory instructions for all color processes; technical data on film, filters, and so on; a basic course in the fundamental principles of color photography, and a book-review supplement. The book will contain four-color illustrations. It will have a moisture-proof cover and spiral

binding; the contents will be cross-indexed with manila separators for ready reference.

The Rhyming Publicist

If prose seems inadequate to the task of singing the excellence of one's ware, try poetry, thinks Eleanor F. Brown, of Burke & James, Inc. So once in a while we receive from her such a missile as

"Any day is washday
For the fellow making prints
So here's a brand new washer
That will give the world's best rinse!"

Then she goes on in prose to give particulars concerning the Luxor Water Powered Tank.

Another time, snappy, readable prose describing the Watson 35mm camera is preceded by this lilting introduction:

"For a candid with color correction,
Other features that really are slick!
Let the Watson be your next selection.
It's priced so your purse cannot kick."

Under Water

A trick by which contact printing can be done without drying the negative, is used, we understand, by some old-timers when the necessity for seeing the result speedily is more important than print quality or permanency. Glass plates are used. After the plate has been fixed and washed, it is placed in clear water. A sheet of contact paper is then immersed in the water and placed in contact with the emulsion side of the plate. Firm contact is assured by carefully squeegeeing the water out with the fingers. Printing is done by an over-head light. We are told that by this method, washing of the print being very brief, the result of a developed plate may be seen on paper within two and one-half minutes.

Living Title

A clever photographic idea for a magazine cover was recently reproduced on the cover of the magazine *Vogue*. A model in a bathing suit who was obviously expert at gymnastics was photographed in five poses, each one in imitation of one of the letters of the word Vogue. The five pictures, taken and reproduced in color, appeared at the top in the usual place for the magazine name. The main illustration on the cover was a repetition of the V pose except that the model's face was in profile, whereas in the magazine name itself her face was in three-quarter pose.

Darkroom Wiseguys

Every camera club probably has one, maybe more. The other day we heard of a chap who was developing some enlargements for perhaps the first or second time. At any rate, he did not know anything about it. After focusing the image on the easel, he gave an exposure of a few seconds, purely from guess (a guess based on total ignorance because guessers may often justify their practice on the basis of long experience) and developed the print for one half minute, after which he pulled it out of the developer and slapped it into the fixing bath. When someone suggested that it might be a good idea to make a test strip first to determine the required exposure time and furthermore that a half-minute developing time was not sufficient to provide a decent black with the paper he was using, he replied: "Maybe it isn't, but that's the way I like to do it." Perfectly silly reply, of course, and we are happy to report that this particular worker has now learned the error of his ways and is beginning to mend them. Those of his type who do not are best discouraged from continuing in the game altogether.

Boys' Clubs Contest

First prize in the National Historical Photographic Contest held by the Boys' Clubs of America at the New York World's Fair, was awarded recently to Francis Hoesch, 14 years old, Boys' Club of Baltimore, Maryland. The picture, "Fort McHenry" (the American flag flying there during an attack by the British in 1814

"Fort McHenry"

was the inspiration for Francis Scott Key's "Star Spangled Banner"), is reproduced here. The prize was an all-expense-paid trip to the New York World's Fair, with a stay of one week, and a complete photographic outfit.

First Camera in America

Identification of the first camera in America and the first "fast action" camera in the world appears to have been made at long last.

according to an Associated Press dispatch from Hampden Sydney, Virginia. The old box-shaped camera left at Hampden Sydney College in 1839 by Dr. John William Draper antedates even the one used by Dr. Draper at New York University to make the first portrait of a living person. The Smithsonian Institution has accepted the camera as the first and will install it among its exhibits.

It took eight years of research by the Rev. Howard C. Cobbs, formerly a professional photographer, to provide the necessary proof. Mr. Cobbs found final proof in a letter by Dr. Draper addressed to *The Photographic and Fine Art Journal*, published in 1858. In that letter he told of working with sensitive plates before Daguerre's and Talbot's announcements, and of experimenting with a large aperture, short focus lens. However, he related that the "first portrait" was made with the help of Daguerre's more sensitive plates and methods.

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WHAT'S NEW

In Photographic Equipment

NEW KODAK 35 ($47.50): With coupled range-finder and Kodak Anastigmat Special lens *f*/3.5 in Kodamatic shutter. Range finder of split-field military type, in which two halves of large image are lined up as lens is focused. Focusing range 4 feet to infinity. Focusing by means of control wheel. Lens mount rigid tubular type. Shutter settings for time, bulb, 1/10th, 1/25th, 1/50th, 1/100th, 1/200th, plus delayed action. Advancing film automatically winds shutter and brings into view small red signal indicating all is ready for next exposure. View finder of optical eye-level type, built into range-finder housing. Slight shift brings eye from range-finder eyepiece to view-finder eyepiece.

RAYGRAM PHOTO COLOR KIT ($1.25): New medium for coloring photographs, transparencies, and lantern slides, devised in laboratories of Joseph Dixon Crucible Co. Enables coloring all positive photographic materials without preliminary sizing or final fixing of colors. Claim: Layman, not trained in art of coloring, with little practice, can neatly and easily do work heretofore attempted only by professional. Kit includes eight colors and shades.

SOLAR TRIPLE SLIDING LENS BOARD ($4.75): Attaches to all models of Solar enlargers except Junior, replacing standard lens board. Slides easily back and forth, permitting instant placement of any lens in optical center of enlarger. Measures 9¼ by 2¾ inches. Sliding member takes three lenses, allows ⅝-inch clearance at back. Board accommodates lenses up to 7¼ inches focal length. Diameter of threaded opening on three lens flanges 1½ inches (38mm). Reducing flanges available at extra cost.

F-R STAINLESS STEEL THERMOMETER ($1): Made of 18-8 stainless steel. Dark blue spirit in glass column shows distinctly against etched calibrations to give accurate readings. Scale registers from 40 to 90 degrees, Fahrenheit. Special clip offers wide use with trays and tanks.

ELECTRONIC PHOTO TIMER ($12.50): Automatic timing control for contact-printing, enlarging, time exposures, and other photographic darkroom operations. Operation simple as ordinary stop watch. Operates on both AC and DC; entirely electronic (no springs, no clock, no motor); silent in operation; easily set, instantly reset; always under control; makes possible printing of 1 or 100 identical pictures from same negative. Strongly built; finished in gray crackle painted cabinet with engraved Bakelite panel.

SUPERFLASH MIDGET PRESS 25 (15 cents): Bayonet base bulb two inches high; output 25,000 lumen seconds and same long-peak characteristics as other Wabash hydronalium wire element bulbs. Permits three or four new bulbs to be carried in same space formerly required for standard bulb of 1937. Other features: Special construction for use in new "concentrating" reflectors; scientific "even light" shape; double jackets of lens-clear safety coating; patented blue Safety Spot. Packed in new ten-bulb Pocket Pack fitting jacket pocket.

KALART MODEL F RANGE FINDER ($24; installation, $27.50): Adjustable lens-coupled range finder featured exclusively on Speed Graphic cameras now available for other filmpack and plate cameras. Adjustable for all lenses from 10.5 to 30 cm; will focus sharply at all distances from 3½ feet to infinity. Installation at Kalart factory. Following is list of filmpack and plate cameras to which Model F can now be fitted: 6 by 9 cm—Bee Bee, Ihagee, Maximar, Recomar, Linhof; 9 by 12 cm—Avus, Ideal, Ihagee, Maximar, Recomar, Welta, Linhof; 10 by 15 cm—Bergheil, Linhof.

TURRET-HEAD FILMO AUTO MASTER, 16mm ($195): Announced by Bell & Howell as first multi-lens magazine loader in industry, who add: "Here is the easiest-to-operate camera in the world—offering instant use of three lenses, automatically positioned view-finders, interchangeable film magazines, and freedom from sprocket threading." Price includes Taylor-Hobson *f*/2.7 lens and view-finder objective. Important features: rotating, three-lens turret, upon which any three lenses may be mounted—wide angle, speed, or telephoto; automatically positioned view-

finders (mounted directly on turret beside each lens is corresponding view-finder objective); "Steady Strap" handle detachable, screwing into tripod socket on bottom of camera; new built-in exposure calculator said to give at a glance correct lens setting for both Kodachrome and black and white film—Kodachrome figures in red, monochrome in black.

Superflash Press 50 (18 cents): New size Wabash flash lamp, with 50,000 lumen-second output plus standard Superflash characteristics of split-second synchronization, extra long peak flash, and adaptability for all cameras, Compur or focal plane shutters, and all synchronizers. Standard No. 2 lamp stepped up from 56,000 to 70,000 lumen seconds; dropped in price to 22 cents.

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THE ROUND TABLE

Questions Answered for the Amateur Photographer

Q. **Can you suggest a method of making glass diffusers?—C. J. K.**

A. You can make your own glass diffuser by obtaining plain glass squares and scratching parallel lines with a glass cutter. Use a ruler as a guide. The closer the lines are to each other, the greater the diffusing effect obtained. You might cut one glass with lines 1/16 of an inch apart, and another with lines 1/8 of an inch apart. If you wish to use only one glass, space the lines 1/16 of an inch and expose through it for only part of the total exposure time.

Q. **I would like to know what kind of developer and the process to use to make a negative print from a negative film.—E. H. T.**

A. This is known as the Paper Negative Process. A contact or enlarged print is made from the negative in the usual way, and the paper print is placed in contact, emulsion to emulsion, with another sheet of print paper. Exposure is made through the back of the positive print just as if it were an ordinary negative. A positive print from the paper negative may then be made by placing the paper negative in contact with another sheet of paper. Processing and developer are the same as usual. Single-weight paper should be used, although the final positive or negative, whichever is the final result you want to achieve, may be printed on double-weight paper if desired.

Q. **I would like to make black and white prints from some of my Kodachrome transparencies. Will you explain the procedure?—R. D. B.**

A. Make a negative by contact or enlargement, the latter method being preferable because you can then use a colored filter to emphasize or repress certain colors. Slow panchromatic film should be used. The process is

similar to that employed in making ordinary prints. However, the film is much faster and the proper safelight should be used, namely, the green, preferably no light at all. The final paper print is then made in the usual way.

Q. **I am using a twin-lens reflex and find that in attempting architectural shots in which it is impossible to photograph from a distance, much vertical distortion occurs. I have wondered whether anyone has devised the use of a prism in front of the lens to correct this condition, the device possibly installed on a vertical axis in a filter mounting.—E. P. G.**

A. We have not heard of any such device and doubt its usefulness. Cameras of the miniature type are designed for general photographic purposes and are made small and compact for convenience, the resulting negatives usually being enlarged. When architectural shots are attempted, the camera is tilted up, correction of the consequent vertical distortion being done under the enlarger by tilting the easel on which the paper lies in the direction opposite to the tilt in the negative. Enlargers are now also available that have a tilting negative holder, which facilitates this work.

Q. **Can you recommend a fine quality sensitizing material which can be applied to glass so as to get a good print?—E. C.**

A. The glass is first coated with the following solution:

Gelatin ....42 grains
Potassium bromide 26 "
Distilled water .... 1 ounce

The gelatin is first allowed to swell in the ounce of water for a full hour. The temperature may then be raised gradually until the gelatin is thoroughly dissolved. While the solution is still warm, add the bromide. In a separate dish, prepare a bath of 32 grains of silver nitrate and one ounce of distilled water. In the darkroom, by red light, slowly add the silver nitrate solution to the bromide gelatin solution. This mixture is then ripened by heat (100 degrees Fahrenheit) for one hour. The emulsion is poured into a glass beaker, the latter then being placed in a 110-degree water bath. Stir frequently and when ripening is complete, add slowly two or three times as much gelatin as was used originally. When this added gelatin has dissolved, place the beaker in cold running water until the emulsion jells, when it is cut into squares with a toothpick. The pieces are then tied up in a cloth bag and suspended in running water to wash for two hours. All this is done in the absence of white light. When the washing is complete, the emulsion may be remelted for coating. Pour a pool of the warm emulsion in the center of the glass and spread it into the corners with a glass rod bent L shape. When dry, expose, develop in D-72 diluted 1 to 4, and fix and wash as usual.

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for.

YOUR CAREER IN BUSINESS

By Walter Hoving

YOUNGSTERS just entering business will find this discussion enormously helpful. It faces squarely that vital social problem of how to get a job and then how to make a success of it. The author, President of Lord & Taylor, gives the answers to those puzzles faced not only by the youngster but also by many who have long been in business but have become mere cogs. Some chapter headings will indicate scope: Business Has Many Facets; Find Out What You've Got—and Use It!; The Thing Called Personality; Apprenticeship; The Square Peg; What's Your Attitude?; The Person Behind The Job; and others equally pertinent. (211 pages, 5¼ by 7½ inches, unillustrated.)—$2.10 postpaid.—*F. D. M.*

COMPLETE GUIDE FOR THE DEAFENED

By A. F. Niemoeller

THE ear; kinds of impaired hearing; causes of impaired hearing; colds, catarrh, diet, glands, drugs, diseases, tonsils, teeth, allergy, psychic factors, otosclerosis, heredity, marriage, swimming, noise, shocks—all in regard to hearing; earaches; occupational deafness; ear wax removal; head noises; ear discharges; oils for the ears; hearing tests; audiometers; re-education; lip reading; how to hear the radio, movies, conversation, telephone, lectures; voice culture; organizations for hard of hearing; periodicals; quacks and frauds; books on deafness; personal adjustment—these indicate the scope of this book which deserves a wide appreciation by the 15,000,000 Americans whose hearing is not perfect. (256 pages, 5¼ by 8 inches, one illustration.)—$3.10 postpaid.—*A. G. L.*

MAKE YOUR PICTURES SING!

By Paul Louis Hexter, A.R.P.S.

WRITTEN in lively, unpretentious style, this book takes the beginner in photography, as well as those more or less advanced, through the entire photographic procedure. Because of its clear language and many illustrations, facts which may have been difficult to grasp are made easily understandable and therefore usable towards the "perfection of technique" that is the aim of Mr. Hexter's book. As a guide to the type of negative the worker should strive for, Mr. Hexter has included in his book an actual negative, from which the reader may make prints or enlargements. (6¼ by 9 inches, 188 pages, many illustrations.)—$3.10 postpaid.—*J. D.*

TURRET LATHE OPERATOR'S MANUAL

By J. R. Longstreet and W. K. Bailey

WAR orders for all manner of guns and ammunition make it imperative that this country have expert lathe operators—more than we have had for years. This complete volume is a course in lathe operation, starting with an historical review and proceeding through classifications of turret lathes, elements, care and maintenance, speeds and feeds, and then taking up the grinding and setting of cutters, drilling, reaming, boring, forming, threading. Other subjects covered are chucks and holding devices, tooling principles, special tools, estimating. Pertinent data are given in a number of tables. (240 pages, 7¼ by 10¼ inches, numerous illustrations.)—$2.60 postpaid.
—*F. D. M.*

THE AIR AND ITS MYSTERIES

By C. M. Botley

IN no sense a text-book, this informal, friendly work treats scientifically the ground that usually is treated in texts. Its scope: the air, the winds, the clouds, rain, thunderstorms, weather, climate, atmosphere and light, sound, upper atmosphere. People who would like to understand the action of the elements will find this elementary book a good place to start. (302 pages, 5¼ by 8 inches, 52 illustrations.)—$3.10 postpaid.
—*A. G. I.*

LET'S FLY

An ABC of Flying, by Lieutenant Ernest G. Vetter

USING the personal pronouns "I" and "you," Lieutenant Vetter gives the illusion that the reader is receiving a course of elementary flight instruction. The course is logical, clear, and in just the right sequence. The book will serve two purposes: to give the lay reader an excellent idea of what is involved in learning to fly; and to give the student pilot an admirable guide which he can read again and again,

no matter what formal instruction he may be receiving. The student pilot will find that the text is not only stimulating but technically correct and above all stresses the elements of safety. (116 pages, many illustrations.)—$1.60 postpaid.—*A. K.*

ELEMENTARY PHOTOGRAPHY

By Gilford G. Quarles

A SUBSTANTIAL work "designed to fill the growing need for a text on photography intermediate between very elementary ones and those of an advanced, technical nature," Mr. Quarles' book is thorough and complete. Starting with a discussion of lenses and cameras, the Assistant Professor of Physics at the University of Alabama immediately plunges into the actual photographic process and carries it to completion. About half the book is then devoted to the technical side of photography, in which the serious worker will find guidance in improving his results. Paper negatives, print toning, print coloring, natural color photography and lantern slides and transparencies are discussed. There is a long bibliography and a useful formulary. (6¼ by 9¼ inches, 350 pages, photographs and diagrams.) — $3.10 postpaid.— *J. D.*

THE PIN-POINT PLANETARIUM

By Armand N. Spitz

FOR each month this book contains a south-facing and a north-facing star chart with constellations. You remove each chart, cut some gores in it, curve it, paste it and thus create a kind of concave chart, through which you prink pins for each star indicated. Then you hold these concaves against the sky and thus you are "inside" of a really analogous chart, instead of outside and hind side backward as with a celestial globe. This is a relatively easy way to learn the constellations. The book also contains constellation facts, a little very elementary astronomy, a list of sky sights (eclipses, planetary positions and happenings) up to 1946, and a glossary. (110 pages, 10 by 8 inches, illustrated.)—$2.10 postpaid.—*A. G. I.*

FIREARMS IN AMERICAN HISTORY—VOLUME II—THE REVOLVER, 1800-1911

By Charles Winthrop Sawyer
Reprint Edition by Lt. Charles Edward Chapel

IN every part of the English-speaking world, arms engineers, gun collectors, historians, museum curators, history students, and teachers bought and praised Charles Winthrop Sawyer's 1911 edition of this publication as the outstanding text on origin and development of revolvers. The edition sold out rapidly and today it is next to impossible to obtain a copy. The firearms world, therefore, owes a debt of gratitude to Lt. Chapel for undertaking to reprint this valuable and

instructive volume, under exclusive permission of the author and copyright owner. This second edition is limited to 1000 copies bound in red cloth with gold stamping and printed from type, not reproduced by off-set or photo-lithography processes. (216 pages, 5½ by 8 inches, 7 plates.)—$4.60 postpaid.—*A. D. R., IV.*

WOODCRAFT

By Bernard S. Mason, Editor, The Camping Magazine

A COMPREHENSIVE book on woodcraft. Trail shelters, teepees, bark shelters, beds, duffel, fire-craft, campfire gadgets, axmanship, caches, bark-craft, woodcraft rope and cordage, woodcraft knick-knacks, woodsy furniture and camp fixings, calumets, rawhide, buckskin, horn, feathers, gourds, tin-can-craft, totem poles—these indicate the scope, which is broader than in similar books. The emphasis is heavily on Indian lore and on the practical: how to do and make. (580 pages, 6 by 9 inches, 294 illustrations.)—$2.85 postpaid.

THE WORLD UNDER THE SEA

By B. Webster Smith

POPULAR oceanography. Introduced by 64 pages of general background matter about oceanographical instruments, the sea bottom, submarine earthquakes and volcanoes, the physics of the sea, currents and tides, this readable book is mainly about life in the sea—marine plants, sponges, jellyfishes, corals, crustaceans, molluscs, starfishes, deep sea fishes, common food fishes, sharks, marine reptiles, mamals, birds. (230 pages, 6 by 9 inches, illustrated.)—$3.10 postpaid.—*A. G. I.*

THE HUNTING RIFLE

By Colonel Townsend Whelen

EXPERT riflemen or mere tyro, the first 15 pages of this book will convince you that it is the finest work of its kind ever published. The author's lifetime of practical rifle experience imparts authority to the easy simplicity of his style. Practical and semi-technical, it clearly and understandingly covers the fields of elementary ballistics, design, selection, use and marksmanship of the American rifle, often termed "The King of All Weapons." This book is virtually indispensable to those who are learning about guns, invaluable to those who know them. (463 pages, 6 by 9 inches, 89 illustrations, index)—$4.85 postpaid. —*A. D. R., IV.*

ORGANES ET APPLICATIONS DU VOL ANIMAL

By Paul Amans M.D., Sc.D.

A CONDENSED treatise on the essential mechanical principles of animal flight, written in French. (200 pages, 6 by 9½ inches, 74 illustrations.)—$1.50 postpaid.—*A. G. I.*

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

OF Springfield type mountings for reflecting telescopes, in contradistinction to the real McKay, which is the straight Springfield originated by R. W. Porter, described in the instruction book "Amateur Telescope Making" and revised by him in its sequel, "Amateur Telescope Making—Ad-

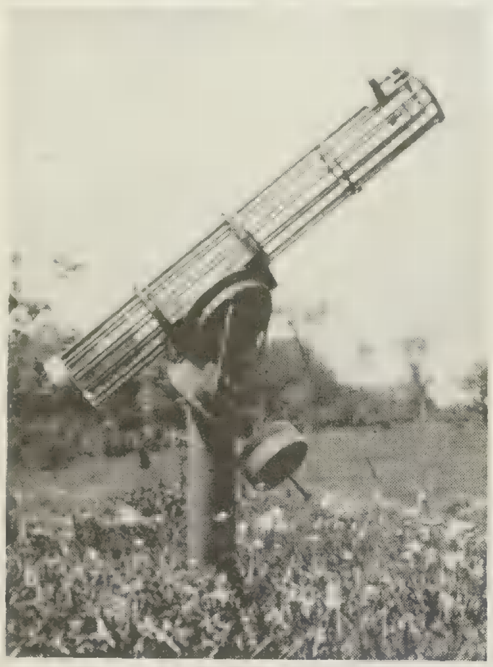

Figure 1: **Phillips mounting**

vanced," there are no end, each different and each ingenious. The one in Figure 1 was made by Robert Phillips, 3448 Greenview Ave., Chicago, Ill. He says the mounting was made from two Buick front wheel assemblies welded together at right angles with struts and cemented into a 5" pipe. Setting circles are marked on the rims of the brake drums and, these being 36" in circumference, it was easy to mark off the divisions, ¼" equalling 2½° in dec. and 10 minutes in R. A. The tube is made of ½" maple dowel stock on rings of plywood—too light according to standards, Phillips says, but he adds that he had no trouble with it. Total cost of telescope was $25.

Another ingenious version of the Springfield type is that in Figure 2, an 8" with Micarta tube and an external framework of structural aluminum angle—a kind of exoskeleton. Carl Oman, 433 Springdale Avenue, East Orange, N. J., is the maker.

When, once before, as above, we called something the real McKay, somebody wrote in to say that the correct expression was "the real McCoy," referring to the late boxing man, Kid McCoy. That, however, is a corruption—one that, in fact, is not the real McKay—of the correct expression. That expression had reference to a fancy whisky once made by McKay in Scotland, pronounced McEye. Anyway, the virtual McCoy-McEye in Springfield mountings, except for its modified counter-weight support, is shown in Figure 3. You don't see many of them because it's a real job of work to make all the necessary patterns, castings, and machined parts. Yet the end-product looks sweet enough to justify the pains if you have the equipment to do the making. Charles F. Pope, 621 Courtland Ave., Park Ridge, Ill., sends in the photograph and says the telescope was made by Richard Traub of Park Ridge. Figure 4 shows Pope's observatory dome, of 20-gage sheet steel over wooden frames.

FLATS are preferred by many, instead of prisms, as diagonals in reflecting telescopes. In the following note Cyril G. Wates, 7718 Jasper Ave., Edmonton, Alta., Canada, discusses the subject pointedly.

"When the amateur has completed a really fine parabolic mirror, and has finished gloating over the beautiful optical 'doughnut' which the Foucault test reveals, he finds himself faced with the problem of diverting the reflected rays through the side of his telescope tube into the

Figure 2: **Oman's mounting**

eyepiece. Shall he use a right-angled prism, or shall he use an aluminized diagonal? I fail to find that sufficient emphasis has been laid upon the relative merits of prism and diagonal, either in these columns or in the pages of 'ATM' and 'ATMA.' Perhaps there is a tendency among TNs to regard the two as optically equivalent, but this is far from being the case.

"Taking the diagonal first, it has one outstanding advantage. Any diagonal mirror, no matter how much its surface may deviate from a plane, is absolutely achromatic. Suitable diagonals with surfaces correct to one quarter wavelength are not too difficult to make, or may be purchased quite reasonably in the smaller sizes. This degree of accuracy is sufficient to insure realization of the fine qualities of a good objective, according to H. H. Selby and others ('ATMA,' p. 131). In the days of silvered surfaces, amateurs were justified in fighting shy of diagonals, but modern methods of aluminizing remove all objections to these little mirrors. Those who make their own diagonals may bear in mind, as I have pointed out in this department (September, 1938), that for long-focus mirrors the difference between a circular diagonal and a 'correct' ellipse, is purely academic. The light cut off by the unused part of a circular diagonal is infinitesimal.

"Turning to prisms, there is one bit of advice which should be burned into the brain of every aspiring amateur —*avoid inferior prisms as you would the plague*. A diagonal mirror has only one place at which it can display defects; the surface. The prism has six: three angles and three surfaces. While it is as easy (and as difficult) to figure the diagonal surface of a prism to the required standard, this perfection will be largely nullified if any of the angles are incorrect, or either of the other surfaces imperfect. A right-angled prism with an accurate diagonal face, but with the other surfaces irregular and the angles incorrect, is exactly equivalent to a bit of cheap plate glass interposed between the eyepiece and the objective. Lack of parallelism between the faces of such a piece of glass would cause color fringes, and irregular surfaces would result in distortion and bad definition.

"Even a perfect prism or a perfect 'plane-parallel' (the two are optically equivalent) causes color dispersion, an effect which, according to Pierce, is quite visible even with a focal ratio of *f*/8. This dispersion, which

Figure 3: **Pope's Springfield**

appears as a faint fringe around such objects as the Moon and Venus, is unavoidable, but is so unobjectionable that the amateur need have no hesitancy in using a prism, provided it is a good one. Reputable dealers will, of course, supply just what is ordered, and it is unreasonable to expect a Grade A prism for the price of a discard. A fine prism is necessarily more expensive than an equally good diagonal, for the reasons already

Figure 4: **Pope and observatory**

stated. For short-focus mirrors, such as the RFT, it might be wise to decide upon a diagonal and avoid any possibility of color fringes, which are much more objectionable with a wide cone of rays.

"What is the standard by which a prism should be judged? First, *all* surfaces should be correct to a quarter wavelength. Second, the angles should be accurate within not more than 3 minutes of arc (Martin). The familiar 'split image' test ('ATM,' p. 54) may be made extremely accurate, especially if a circular diaphragm or washer is used between the eye and the prism (Pierce); but this guarantees the correctness of the right-angle only; it is perfectly compatible with gross errors in the other angles. If you are in doubt, go to the physics department of the nearest university and get them to measure the angles for you.

"A word with regard to collimation of a prism. The prism mounting must be adjustable in *all* directions. Push-pull screws are hard to beat, combined, of course, with a rod sliding in the boss of the spider. Eliason's method of reflection from the eyepiece face of the prism is excellent ('ATMA,' p. 272), but does not go far enough. The eyepiece face may be at right angles to the optical axis of the adapter tube, yet the mirror face (of the prism) may be hopelessly out of adjustment.

"It is advisable, therefore, to extend Eliason's adjustment by some such method as that shown in Figure 5, which has worked out well in practice. A disk of cardboard is attached to the mirror end of the tube. In the exact center of the disk is a hole (at least ¼", to avoid diffraction), with two heavy black lines drawn diagonally through the hole, as shown.

The disk is illuminated by means of a flashlight, the end of the tube being covered by a black cloth.

"The prism is first adjusted to the eyepiece adapter by Eliason's method. It is then further adjusted by watching the reflection of the diagonal lines and eyehole, in the mirror face of the prism. When this adjustment is correct, the push-pull screws *must not be altered again*. If the prism no longer responds to Eliason's test, it

Figure 5: **Suggested by Wates**

must be corrected (1) by sliding the prism mounting in its collar, (2) by rotating the prism, (3) by altering the alinement of the eyepiece adapter. If this method is pursued, *both* square faces of the prism will be exactly at right angles to the axes of both tubes.

"If, after the prism is squared up as described, the mirror is not centered as seen through the adapter tube, the prism is probably bad, and Porter's method for warped mirrors should be tried ('ATM,' p. 287).

"Finally, by all means use a prism if you can afford a really good one, but remember that bad collimation may cancel all the perfection for which you have parted with your hard-earned dollars. If funds are somewhat limited, use a diagonal, especially with short-focus mirrors. For absolute freedom from color effects, the diagonal is certainly the choice, but even a hard aluminum film is delicate and subject to scratches. A prism is free from this objection. So there you are!"

Wates calls for prisms flat within a quarter wavelength and with angles within better than 3 minutes of arc from perfect ("pyramidal error 3′," the professional would term this). Just how good is this, compared with the prisms amateurs have been buying? Definite data are not available on the quality of all the prisms sold to amateurs in the past but here are some criteria. The Perkin-Elmer Corporation, professionals, rate prisms as follows: A-quality-precision, 1/8 wave or better and 5″ pyr. error, or better. A-quality, 1/8 to ¼ wave and 1′ pyr. error or better. B-quality, ¼ to ½ wave and 5′ or better. C-quality, 1 wave and 10′ or better. Thus, the prism Wates asks for is, after all, nothing especially superlative, falling in Class B and costing, for a prism with one-inch-square face, between $3 and $5. How many, if any, Class D, E, F, G . . . X, Y, Z prisms have amateurs purchased in past years?

Your scribe recalls his first telescope, which had a prism picked up free because it was a reject. You could have thrown a cat through the gap between its face and a try-square, yet the telescope provided a big thrill, at least for a little while, even if the prism did make of it almost a spectroscope. At that time, 1926, the amateur telescope making hobby was a cub with burrs in its hair. Porter's statement, in "ATM," page 54, written also at about that time, that "the right angle of the prism need not be exactly 90° for our purpose," didn't seem and then wasn't much out of place. It is literally true today—within the tolerance quoted by Wates from Martin, but the language will be altered in future reprintings. Also by this test a prism could have a perfect right angle, yet the other angles might be, say, 44° and 46° respectively, without the tester being the wiser. Pierce claims that, with the prism held at 30″, the split image test is good to 34 seconds of arc. If made with a small telescope this accuracy would be correspondingly multiplied, he points out.

Wates next continues with the description of a diagonal support of his design:

"The 'classic' method of adjusting the diagonal by means of one or more slots in the tube is not only poor mechanical construction, but also has the serious objection that, when the screws are moved in the slots, the diagonal is swung away from the optical center of the tube. My earlier design, which appeared in the October, 1935, number, is satisfactory for a prism, but is too bulky for an elliptical diagonal mirror. The design shown in Figure 6 has been used in an RFT and can be adapted for any size telescope. Because of the spherical surface between *A* and *B*, the diagonal moves as though pivoted on the optical center, thus greatly simplifying adjustment.

"The diagonal is mounted in a brass tube, as described by Hindle in 'ATMA,' except that the space between the glass and the plate *A* is packed loosely with coarse steel wool. The top surface of *A* is turned to a

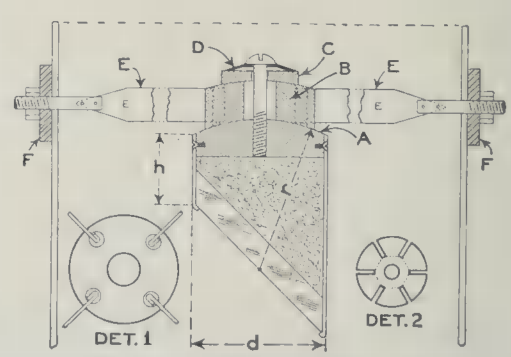

Figure 6: **Wates' support**

spherical surface with radius *r*, which could be measured with a caliper, but may be more accurately determined by the use of the equation

$$r = \sqrt{h^2 + hd + \frac{d^2}{2}}\ .$$

"The method of attaching the four vanes *E* to part *B* is shown in Detail 1. The slots in *B* are cut carefully with a fine hacksaw. Note that the slots are slightly off-center. Half an inch of the ends of each vane is softened and tinned. One eighth inch is folded over, to fit into the holes in *B*, which

is then heated and the holes filled with solder. The tube of my RFT being sheet aluminum, the wrought iron ring *F* was used for stiffening.

"*D* is a spring steel washer, shown in Detail 2. The diagonal and its mounting can be moved in any direction without changing the position of its optical center and, when correct, the screw is driven home.

"In turning the three disks, *A*, *B*, and *C*, templates, both concave and convex, should be cut; one pair to radius r and the other to radius r plus the thickness of *B*. After turning to correct curve, the various surfaces may be ground together with fine Carborundum.

"To forestall the criticism that there is no provision for longitudinal adjustment I will say that, although such adjustment can be provided, it is quite unnecessary. If the spider ring is accurately mounted on the tube, the center of the diagonal will be in line with the center of the eyepiece tube. If not, the ring can be moved until it is correct, and then permanently fixed."

In the May number of *The Journal of the British Astronomical Association*, F. J. Hargreaves describes his pet polishing lap—wax on pitch, as follows: "The wax-on-pitch polisher consists of an under-layer of pitch supporting wax facets on a netting foundation. The wax does not yield or flow under pressure, and therefore the grooves between the facets do not fill up in use, as with polishers of pitch only. The pitch under-layer, however, can yield or flow to allow the wax facets to make contact uniformly with the surface being polished. This under-layer can therefore be made as soft or as hard as desired, according to circumstances, leaving the wax-polishing layer unaffected." Grim are the circumstances under which this is reported in summer, from a meeting on the banks of the Thames.

From S. L. Walkden, father of the RFT or Richest-Field Telescope, who lives in London, came, in the midst of the liveliest bombardment, a long letter about telescoptics and not a syllable about the war except to say that, London being permanently blacked out, he found with rejoicing that he could see fully three magnitudes of stars that previously were invisible, and with his own RFT he had found some thrilling Milky Way views.

Your scribe lives in a New Jersey suburb on a corner surrounded by eight street lamps and bathed by three flood-lamps from a filling station, and the only time he ever even *sees* the Milky Way is when out of town.

In case you are planning to use the King test ("ATMA," p. 269) and have intended to use the sugar and water solution suggested, don't; it won't work. Other liquids—oils—have been substituted. Write in and ask, if especially interested.

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

Preparedness

A RECENT amendment to the patent laws is intended to reënforce the preparedness program. The amendment grants to the Commissioner of Patents the right to withhold the publication and granting of a patent for such period or periods of time as in his opinion the national interest requires, where the publication of the invention would be detrimental to the public safety or defense. In this way inventions dealing with ordnance, bombs, or other military or naval weapons may be kept secret so as to prevent them from falling into the hands of foreign agents.

Heretofore many important inventions of this character were patented. Upon the issuance of the patents the inventions were published and were available for reference. The withholding of a patent might possibly work a hardship upon an inventor since he can only collect profits and damages for infringements occurring subsequent to the granting of the patent. In order to protect the inventor the amendment to the law also contains the provision that an applicant whose patent is withheld by the Commissioner shall tender his invention to the government and thereafter he shall have the right to sue for compensation in the Court of Claims, the compensation to begin from the date of use of the invention by the government. Thus it will be seen that the inventor can recover, from the government, compensation for the use of his invention occurring even prior to the granting of the patent.

Caruso

COMPETING manufacturers of food products were involved in a controversy over the right to register as a trade mark the name of the famous tenor, Enrico Caruso. The original user of the name Caruso had registered it in the United States Patent Office in 1918 as a trade mark for macaroni and similar food products. The other manufacturer registered the name as a trade mark for canned tomatoes and tomato paste in 1923. Subsequently the original user brought proceedings to cancel the later trade-mark registration of the other manufacturer.

It was argued by the second registrant that he had the right to maintain his registration because he had received permission from Mr. Caruso to use his name and picture in connection with his food products. The Patent Office and Court of Customs and Patent Appeals found that both registrants had received permission from Mr. Caruso to use his name and picture. It was held, however, that this *per se* was not controlling. The right to register a trade mark is controlled by the federal statutes relating to this subject and a person may not register a trade mark which is likely to cause confusion in trade. It was held that the registration of the name Caruso by the second registrant was likely to cause confusion with the trade mark of the first registrant and accordingly it was ordered to be cancelled.

Superman

A CARTOON strip relating to a fictitious character of superhuman strength identified as Wonderman was held to be an infringement of a copyright relating to a cartoon relating to a superhuman character identified as Superman. Each character was represented as being the strongest man in the world, as being the champion of the oppressed and as battling against evil and injustice. Each was represented as performing similar feats of superhuman strength such as crushing a gun in his hands and as catching the bullets or shells from a gun and throwing them back to the place whence they emanated. It was contended by the infringer that the copyright was invalid because the cartoon character Superman was merely a comic Hercules. This argument was rejected by the Court for the reason that an original production or creation, however poor in quality, is entitled to copyright protection.

In this connection, the Court stated: "But if the author of 'Superman' has portrayed a comic Hercules, yet if his production involves more than the presentation of a general type, he may copyright it and say of it: 'A poor thing but mine own'."

Ascap

A NEBRASKA statute which would have destroyed or seriously handicapped an organization through which a large number of authors, composers, and publishers of musical compositions receive substantial income for the production of their compositions was recently declared unconstitutional by a Federal Court. This statute declared it to be unlawful for authors, composers, and publishers to form any society, association, or

similar combination wherein the members constituted a substantial portion of the authors, composers, and publishers within the United States and when at least one of the objects of the combination was the determination and fixation of license fees.

The statute provided further that thereafter all license fees fixed by such a combination were null and void and that authors, composers, and publishers should specify on printed copies of their musical composition the license fees charged for private and public renditions of the composition. Upon payment of the specified fee the purchaser of the composition could use or render the composition without any further obligation.

The statute also provided that if the author, composer, or publisher failed to specify a license fee on printed copies of the composition then any purchaser thereof was free to use and render it without the payment of any license fee whatsoever.

The American Society of Composers, Authors, and Publishers, an association of approximately one thousand composers and of 123 publishers, commonly known as Ascap, brought suit against the Secretary of State of Nebraska to enjoin the enforcement of the statute on the grounds that the statute was unconstitutional. The Court held that the provision of the statute requiring the owner of a copyrighted musical composition to offer it for sale in a certain manner, i. e., by specifying a license fee on printed copies of the composition and the provision depriving him of any compensation if he fails to offer the composition for sale in the manner specified was in violation of the Federal Constitution and also of the Federal Copyright Act in that it denied the copyright proprietor due process of law.

Bacteria

THE lowly bacteria which has been accused of causing many of the human woes and illnesses has now been deprived of the benefits of our patent law.

The patent law provides in part that anyone who has invented or discovered any new variety of plant which can be asexually reproduced is entitled to receive a patent. Under this section of the law an attempt was made to obtain a patent on a new form of bacteria. The Patent Office rejected the application for the patent on the grounds that a bacteria was not a plant within the meaning of the patent law.

An appeal was taken to the Court of Customs and Patent Appeals and the court ruled that while scientifically a bacteria was a plant, Congress intended that the word "plant" should be given its popular meaning and this did not include bacteria. The Court accordingly sustained the Patent Office in refusing to grant a patent for bacteria.

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

PLASTICO ROK SERVICE BULLETIN is a pamphlet showing a wide variety of uses for the mending and patching plastic material which was described on page 222 of the April 1940 issue of Scientific American. *Technical Supply Co., Palo Alto, California.—Gratis.*

THE DENSITOMETER AND ITS USE IN COLOR PRINTING is a manual published for use with the Marshall Densitometer. However, it offers valuable information to all interested in making color prints. Text and illustrations are non-technical. The manual covers, in comprehensive form, such important points as: instructions outlining the general requirements of good color prints, how to make accurately balanced separation negatives, how to use gray scales, general use of densitometers in color work, how to check separation negatives, etc. Included are time-gamma charts, filter factors, etc. Gratis to purchasers of Marshall Densitometer; 25 cents to others. *Albert Specialty Co., 231 South Green St., Chicago, Illinois.*

RESEARCH LOOKS TO NEW HORIZONS is a 32-page booklet, illustrated in colors, showing the progress of research and industry from early horizons to the present day. Specific examples show the startling results that have been obtained by research intelligently applied. *Department of Public Relations, General Motors Corporation, Detroit, Michigan.—Gratis.*

TENITE is a 28-page booklet that describes this plastic material and illustrates many of its uses in a wide range of industries. The book is of particular interest to manufacturers, molders and designers. Please request it on your business letterhead. *Tennessee Eastman Corporation, Kingsport, Tennessee.—Gratis.*

DU PONT'S PARTNERSHIP WITH THE FARMER is a booklet which shows clearly that both products for the farm and those made from farm products have been made available through chemical research. The booklet also shows how many farm products, after processing, go back to the farm either for direct use or as aids in the preservation and marketing of other farm products. *Agricultural News Letter, E. I. Du Pont de Nemours & Co., Inc., Wilmington, Delaware.—Gratis.*

THE WORKING OF S. A. E. NICKEL ALLOY STEELS is a 16-page pamphlet of data compiled from the practice of 34 leading fabricators. It covers effects of heat treatment, and gives practical instructions for machining, grinding, welding, and gas cutting. *The International Nickel Company, Inc., 67 Wall Street, New York, N. Y. —Gratis.*

"HAM GUIDE" was written specifically to tell the radio amateur how to use RCA transmitting tubes to best advantage. It also includes constructional articles, giving complete details for building two medium-power amateur transmitters. More than 70 illustrations and over 30 transmitting circuits are presented. *Commercial Engineering Section, RCA Manufacturing Company, Harrison, N. J.—15 cents.*

A NATIONAL TRANSPORTATION POLICY, by Senator Clyde M. Reed, is a 14-page booklet that outlines the problems of transportation in the United States and presents facts aimed toward their solution. *Association of American Railroads, Transportation Bldg., Washington, D. C.—Gratis.*

ALPHA SYSTEM OF BRIDGE DESIGN is a 26-page illustrated booklet that describes a system of steel and reinforced concrete construction relating particularly to bridges. It is claimed that this system combines the rigidity of reinforced concrete with much lower cost and gives the accuracy, simplicity, and rapidity of steel construction. *Porete Mfg. Co., North Arlington, New Jersey.—Gratis.*

PLATING AND FINISHING GUIDEBOOK comprises 136 pages of practical information in the plating and finishing industries, plus 70 pages of advertising and "quick-mailing coupon service" for readers. The text consists of a series of articles covering all phases of plating and finishing. *The Metal Industry Publishing Co., Inc., 116 John St., New York City.—25 cents.*

G-E HOME WIRING HANDBOOK is a 24-page pamphlet that is essentially a guide for planning electrical wiring for homes. It outlines wiring requirements and specifications, shows how to determine the adequacy of wiring, and gives a chart of residential outlet requirements. *General Electric Company, Bridgeport, Connecticut.—Gratis.*

CUT STEEL PROFITABLY WITH KENNAMETAL TOOLS AND BLANKS is a 6-page folder describing this tool alloy. It includes tables of comparative physical properties and recommended speeds for machining steels of various hardnesses. Illustrations show typical turning, milling, and shaping operations. Bulletin 740. *McKenna Metals Co., 341 Lloyd Ave., Latrobe, Pa.—Gratis if requested on business letterhead.*

C. P. CHEMICALS AND ACIDS is a 158-page catalog of "Baker's Analyzed" laboratory and technical chemicals. *J. T. Baker Chemical Company, Phillipsburg, New Jersey.—Gratis.*

SCIENTIFIC AMERICAN

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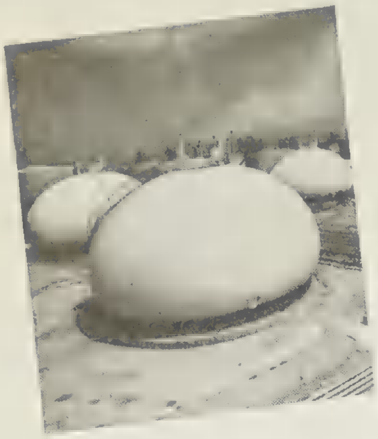
NINETY-SIXTH YEAR ▪ ORSON D. MUNN, Editor



HORTONSPHEROIDS in a modern refinery in the West Indies are the interesting objects shown on our front cover. These have a capacity of 20,000 barrels each and are used to store gasoline under two and one half pounds pressure to reduce excessive evaporation losses.

NOVEMBER · 1940

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OUR *Point* OF VIEW

SCIENTIA OMNIA VINCIT

NYLON, it was said in these pages last month, probably will not cut deeply into the Japanese silk industry for five to ten years. When and if it does, that will be the Japanese farmer's worry; what disturbs some cotton men is the expanding use of rayon. Indeed, to that fiber is attributed a sizeable part of the problem now facing American cotton farmers.

Rayon production has increased nearly a thousand percent since 1924, says the *Industrial Bulletin* of Arthur D. Little, Inc. Yet, reports that circular, it was not until 1938 that rayon consumption exceeded that of scoured wool and became a poor second to that of cotton. And if rayon consumption doubles in the next decade, it will still total a third of current cotton consumption.

Growers of the natural fiber, nevertheless, may not rest content. That one third is the equivalent of several million bales of cotton. Already an increasing production of cotton abroad is cutting into our exports, may cut far more heavily as the years pass. And with rayon taking a larger share of the home market's cash, it seems appropriate that the American cotton farmer take stock of the situation and readjust his economy in time to meet and weather the storm. Assuredly, rayon is going to be used more widely in rugs, tires, many fabrics that now commonly use cotton, and, in "staple fiber" form, as a mixer with cotton fibers in cloths traditionally made of cotton.

There is one bright light on this dark horizon. Down in North Carolina, there have been under way for years experiments in turning the whole cotton plant—stalk, leaves, boll, and fiber—into rayon. The plants are mowed down; oil is extracted from the seeds in this bunch of sticks and fiber by use of solvents; and the remaining cellulosic material is made into rayon. Years ago, this process was a laboratory success. If and when it is made commercially practicable, it will save our trees—which now go into rayon—will take up surplus cotton stocks, and will sidestep that part of cotton production which is more costly than all others combined: the picking job.

For decades, the cotton grower has been roundly scolded for concentrating stubbornly on his one crop. Still, he sticks to it. Perhaps he cannot interpret the handwriting on the wall, "Science conquers all," as saying that science replaces the old with the new. If he doesn't now make a determined effort to understand, he may soon be complaining of technological displacement.—*F. D. M.*

DEFEND YOURSELF OR DISARM

THE right of the American citizen to bear arms, secured by the Constitution of the United States, has definitely been abridged by local and state laws, but has never—*yet*—been completely rescinded. That "yet" is important. If certain fanatical anti-firearms groups were permitted to have their way, every sporting arm in this country might have to be registered and its owner duly "mugged" and fingerprinted. Or, even worse, such firearms might be subject to confiscation or to storage in some public place when not in actual use.

Every sportsman who uses firearms—whether he "plinks" with a .22, is a devotee of skeet or trap, or likes to punch holes in paper targets with rifle or pistol—should be aware of the dangers that threaten his sport. Anti-firearms fanatics formerly used the crime-prevention pretext for proposed legislation. Now they have a new one. National defense! They would keep weapons out of the hands of fifth columnists by taking them away from everyone! And just as does the thug and crook, the fifth columnist will hide his firearms where they are readily available, while the law-abiding citizen complies with the rules and leaves himself unarmed! The theory is beautiful, but it does not work out in practice.

In this same vein, Eltinge F. Warner, well-known sportsman and publisher of *Field and Stream*, holds up Switzerland as an example of a free nation where anti-firearm agitators would never be happy. "For many months," says Mr. Warner, "little Switzerland has been surrounded on all sides by warring nations, but up to today she has not felt the tramp of hostile armies. When a war plane crosses the Swiss border, the Swiss open fire. She is small, but she is mighty. Rumors have been current that armies would march across Swiss soil, yet up to date Switzerland is the only country in the theater of war that has not been ridden over roughshod.

"The citizens of that courageous republic," continues Mr. Warner, "don't keep their guns in public armories. At all times the citizen of Switzerland has a military rifle within reach, and he knows how to use it. Every young man is an army graduate. When he has completed his military training, he takes his government rifle or hand-gun home with him. And each year thereafter he is allotted a certain amount of ammunition and required to shoot this ammunition in order that he may keep familiar with firearms and know what a good rifle and a good pistol or revolver can do. Even the most rabid anti-firearm crank must admit that Switzerland would be an unhealthy place for hostile parachute troops to land."

We cannot help recalling that this vast nation of ours was virtually built by men whose very lives and livelihoods depended on their skill with firearms. True, the march of civilization has changed this picture materially, but it can never change the love that millions of American men hold for firearms and their use. It rests in the hands of these same men—you and I—to preserve for all of us the right to own and use rifles, hand guns, and shot-guns in the pursuit of sport and recreation. Make use of our democratic processes by letting your legislators know *now* that you, together with millions of others, want no interference with your rights in this matter. Write. Telegraph. Make yourself heard in the halls of Congress.

National defense by disarming the citizens! By the Red Gods, what a travesty!—*O. D. M.*

50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of November, 1890)

CANAL—Recent cable advices report that work is being energetically pushed on the Nicaragua Canal. . . An aqueduct twelve miles long, to bring pure water from the mountain streams, is being laid. Offices, hospitals, and quarters for employes of the company, adequate to the present needs, have been erected. Several millions of feet of lumber have been received from Atlantic and Gulf ports, and cargoes are continually arriving.

LIGHT COST—Incandescent electric lamps are lessening in cost of manufacture while, at the same time, increasing in efficiency, that is to say in length of life. . . Now, with improvements in exhausting apparatus, it costs but a tithe of the old figure to produce a more perfect vacuum; the sealing of the platinum wires is done by machinery, and as a result a far more certain and a longer-lived lamp than that which once cost $1 may be had for considerably less than the half of it.

WAR TRENDS—The conditions under which the next armed conflict between powerful countries must take place are of an altogether different character from those known heretofore; but in such future contest, come when it may, it is safe to say that science and skill, rather than brute force, will have a determining influence to an extent never before known in the annals of war.

HORSE MEAT—Just twenty-four years ago the first horse butcher in Paris opened his shop. Since then there have been started nearly 140 horse flesh shops in the department of the Seine, and at the present time about 20,000 horses are killed every year in Paris for human food. In Paris the price of the meat is less than half that of ordinary butcher's meat. Berlin is following the example of Paris.

LUMBER—In 1880 the 25,708 saw mills then in operation converted $120,000,000 worth of raw timber stock into various kinds of lumber; at the same rate there would be no good-sized timber left in forty years.

EFFICIENCY—Another path in which the American iron works can now develop is in that of reducing wastes of fuel and of material. Now that mechanical engineering has developed machinery for handling to such an extent that the smallest possible amount of manual labor is required, the engineers might be allowed to take a rest in this direction and devote themselves to perfecting the steam boilers and engines and furnaces, with a view to saving fuel.

COLUMBUS—In the confusion of new and old times, and of different years . . . it is far from easy to determine the exact anniversary of Columbus' first sight of our shores. Four hundred years ago many discrepancies existed in the times of celebration of Christmas, and there is even a possibility that the year should be 1491 or 1493.

STREET LIGHTS—One of the companies in Paris that deal in compressed air for motive power has been awarded the contract for street lighting on a novel plan. The company distributes power through its condensed air system to an immense number of small dynamos, each of which furnishes current for a small number of lamps.

TORNADOES—A special investigation of the subject of tornadoes has been carried on by Prof. H. A. Hazen, of the Government Signal Service, during the past year. . . It appears that in no State may a destructive tornado be expected oftener, on an average, than once in two years, and that the area over which the total destruction can be expected is exceedingly small.

UNDERGROUND—Among the new works lately inaugurated in London is an underground electric railway known as the City and South London Railway, 3¼ miles in length. . . The road-bed consists of two tracks 4 feet 8½ inches in width, which are laid in two underground tunnels, each 10½ feet diameter. . . There are four stations.

One of the peculiarities of the work is its great depth underground, the rails being, with few exceptions, not less than 40 feet below the streets, while in some places they are 100 feet underground. At the stations the two tunnels are brought into an enlarged chamber built underground, and from these passengers are raised by elevators to the street level. The cars are propelled by electric locomotives, of which fourteen have been supplied. . . The locomotives are able to make a speed of 25 miles an hour, but the trip of 3¼ miles, making four stops, is made at the rate of 15 miles an hour.

GROWTH—In Denmark and Sweden it has been the custom for many years to weigh and measure the school children every year. Out of 15,000 boys and 3,000 girls the results were as follows: In the seventh or eighth year of life boys grow considerably in height and in weight, after which a delay sets in which reaches its maximum in the tenth year and lasts till the fourteenth year, when a considerable acceleration of growth suddenly sets in.

INSULATION—There is great need of improvements in insulating material. An insulation for wires is needed that will be cheap, light, flexible, and durable; one that dampness will not decay, nor the heat of an electric arc dissolve or burn.

PAPER PIPES—Gas pipes from paper are made from strips of manila paper equal in width to the length of the pipe to be made, which is passed through a vessel with melted asphalt, and then wrapped firmly and uniformly around an iron core until the required thickness is attained. The pipe is then subjected to powerful pressure. . . These pipes are claimed to be perfectly gas tight . . . and very resisting to shocks and concussions.

BROWSING with the Editor

THROUGH THE SCIENCE LITERATURE OF THE WORLD

TO CORRECT WIDESPREAD MISCONCEPTIONS—During a five-year test, F. H. Frankland, Chief Engineer of the American Institute of Steel Construction, observed that in a wind of 80 miles per hour the Empire State Building in the City of New York took a temporary lean of about 2¾ inches, and then swayed across that lean at the rate of 7.85 times per minute through an eight-inch arc. Thus, at one end of each sway the building reached 6¾ inches out of plumb away from the wind, and at the other end returned to 1¼ inch beyond plumb toward the wind.

REFRIGERATOR MILEAGE—The compressor motor of an electric refrigerator travels the equivalent of 250,000 miles in five years' normal operation—enough to carry it around the world 10 times if it could travel under its own power.—Notes, Westinghouse Electric & Manufacturing Company.

A TRAIN EVERY FIVE SECONDS—Approximately 18,000 passenger trains and about 15,200 freight trains operate daily over the tracks of the American railroads. On this basis, a passenger train starts on its run somewhere in the United States every 4.8 seconds, and a freight train starts on its run every 5.7 seconds, day and night, on the average.—Association of American Railroads.

MOTH LARVAE CRAWL IN—Experiments prove that a flying moth will lay her eggs in the crack of a chest or closet and the larvae when hatched will have no trouble crawling into the container if the opening is about the thickness of newsprint paper. Sealing with gummed tape is recommended.—Wallace Colman, United States Bureau of Entomology and Plant Quarantine.

CHEESE MINES—Much Roquefort type cheese, which requires to ripen an atmosphere nearly saturated with water and varying but slightly from 48 degrees, Fahrenheit, is being made in quantities in this country—in caves along the Mississippi near St. Paul; in rooms into which icy water trickles constantly, turning a fan for gentle air circulation; in abandoned coal mines; and in numerous small caves.—*The Industrial Bulletin* of Arthur D. Little, Inc.—No. 159.

MOTES—Research engineers have measured more than 100,000,000 dirt particles in a single cubic foot of air in one particularly dirty city.—Notes, Westinghouse Electric & Manufacturing Company.

WAR EXPORTS—For war supplies, Japan has depended primarily on seven countries headed by the United States. In percentages, imports of such supplies from these countries were as follows: United States, 55.7; British Malaya, 8.7; Canada, 8.5; Netherlands Indies, 8.3; Germany, 4.3; British India, 3.3; Italy, 1.3.—Dr. T. Y. Hu, Chinese Council for Economic Research.

COLONIC IRRIGATION—It is extremely difficult to determine the field of usefulness, if any, of colonic irrigation. While the role of the small cleansing enema and of the medicated retention enema seems well established, colonic lavage has been outrageously exploited in many quarters. There is little evidence to show that it may benefit diseases of the colon and there is none for the stomach. On the other hand, it may cause harm.—*The Journal of the American Medical Association*, August 3, 1940, page 404.

COLDER ICE—Ice men in Bangor, Maine, have found that their crystal-clear natural ice, frozen at —20 degrees, Fahrenheit, lasts longer than artificial ice frozen at 15 degrees. The ice is used extensively in air-conditioning Pullman cars between Bangor and Boston.—*Taylor Rochester*, Summer Edition, 1940.

YARN—Some cotton yarn is so fine that 50 miles of it are needed to make one pound. This yarn is spun on ordinary textile machinery to make typewriter ribbons, airplane fabrics, and fine dress goods.—R. J. Cheatham, U. S. Department of Agriculture.

ROSE INDUSTRY—More than one half of the world's supply of rose-bushes, or 20,000,000 per year, are now grown commercially in Texas. They are of 16,000 varieties. The industry, mainly in eastern Texas, ships rose bushes to every state and to 25 foreign countries.—Notes, American Petroleum Institute.

COMMON PIMPLES—Among Eskimos, native black Africans, Australian aborigines, and Maoris, acne vulgaris appears to be a much less common disorder than it is among civilized white people. As the Maoris adopt modern methods of living, the condition occurs more frequently.—*The Journal of the American Medical Association,* August 17, 1940, p. 555.

AIR CONDITIONING—Schools of air conditioning and refrigeration attract students with glowing promises of work in an uncrowded field, fail to give proper training, and much bitter disappointment is the result.—*Refrigerating Engineering.*

SCIENCE FRUSTRATED, PERVERTED—The function of science is to unite the whole human family, whereas the function of politics seems to be, both in the case of the human family and of each nation, to create parties and to emphasize them as much as possible.—*Nature,* August 3, 1940.

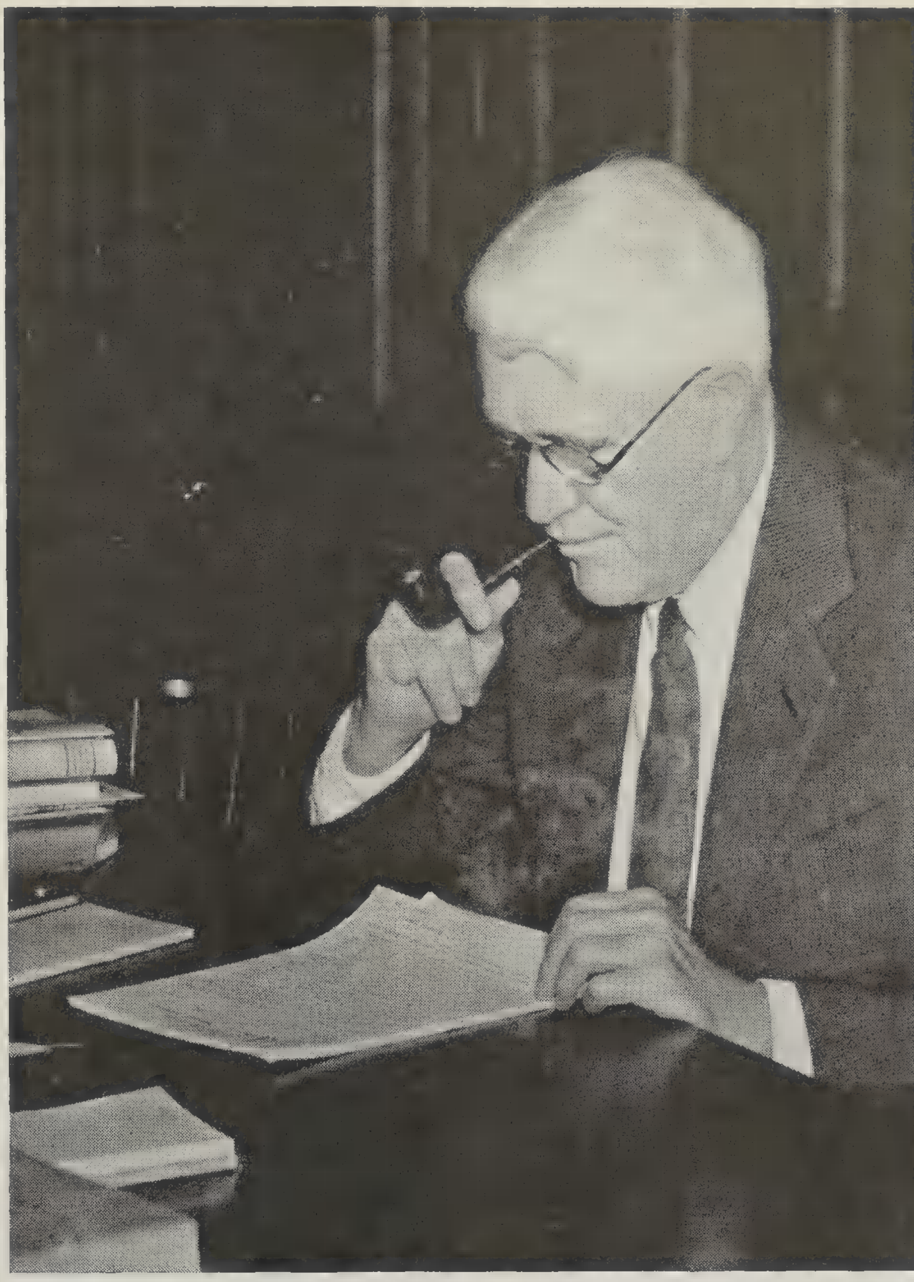
MILK WINE—Either sherry or sauterne type wine can be made from milk whey. So far, however, only seven bottles of milk wine have been made. It has an alcoholic content of 15 percent by volume.—Notes, National Dairy Products Corporation.

EFFECT OF SCIENCE—The chances of a new-born child reaching age 65 are today as great as the chances of reaching 50 were only 30 years ago.—Dr. Louis I. Dublin, Metropolitan Life Insurance Company.

TOOL ALLOY—Important to our national defense program, the steel-cutting tool material, Carboloy, was produced in July in a quantity four times that of July 1939. Also exceeded was the previous peak month of June 1940. —Notes, Carboloy Company, Inc.

WIDOWS—Every year about 400,000 wives in the United States become widows. The average age of widows at the death of their husbands is somewhat less than 55 years, and practically one quarter of them—that is, about 100,000 —are at ages under 45.—*Statistical Bulletin,* Metropolitan Life Insurance Company, August, 1940.

Personalities in Industry



WILLIAM H. MASON

When William H. Mason was six years old he admired a new two-wheeled "break-cart" on his father's horse farm in West Virginia. Here, he saw, was a vehicle getting along with half as many wheels as usual. Why, this youngster thought, couldn't you go one step farther and have a one-wheeled cart? He labored and whittled and finally produced a one-wheeled cart, but it turned out to be only a wheelbarrow. He was disappointed, but he had taken his first step in a career of invention.

Mason is not the wild-eyed, long-haired type of genius. Now, as vice-president in charge of research of Masonite Corporation—a huge concern that sprang from his own research—he is intensely human and exceedingly modest. Rather than talk about himself, Mason, if you will let him, will invariably swing the conversation around to one of his pet subjects, the late Thomas Alva Edison, with whom he was associated for 17 years.

Much of Mason's youth was spent breaking and training trotting and gaited horses. After several years at Washington & Lee, he transferred to Cornell to study mechanical engineering. When the Spanish-American war broke out he left college to become a naval engineer.

After a shoe factory job, Mason went to work as a draftsman in planning Edison's new cement plant at New Village, New Jersey. Mason was retained by Edison to help supervise actual construction of the plant, and later became building superintendent of all of Edison's various enterprises.

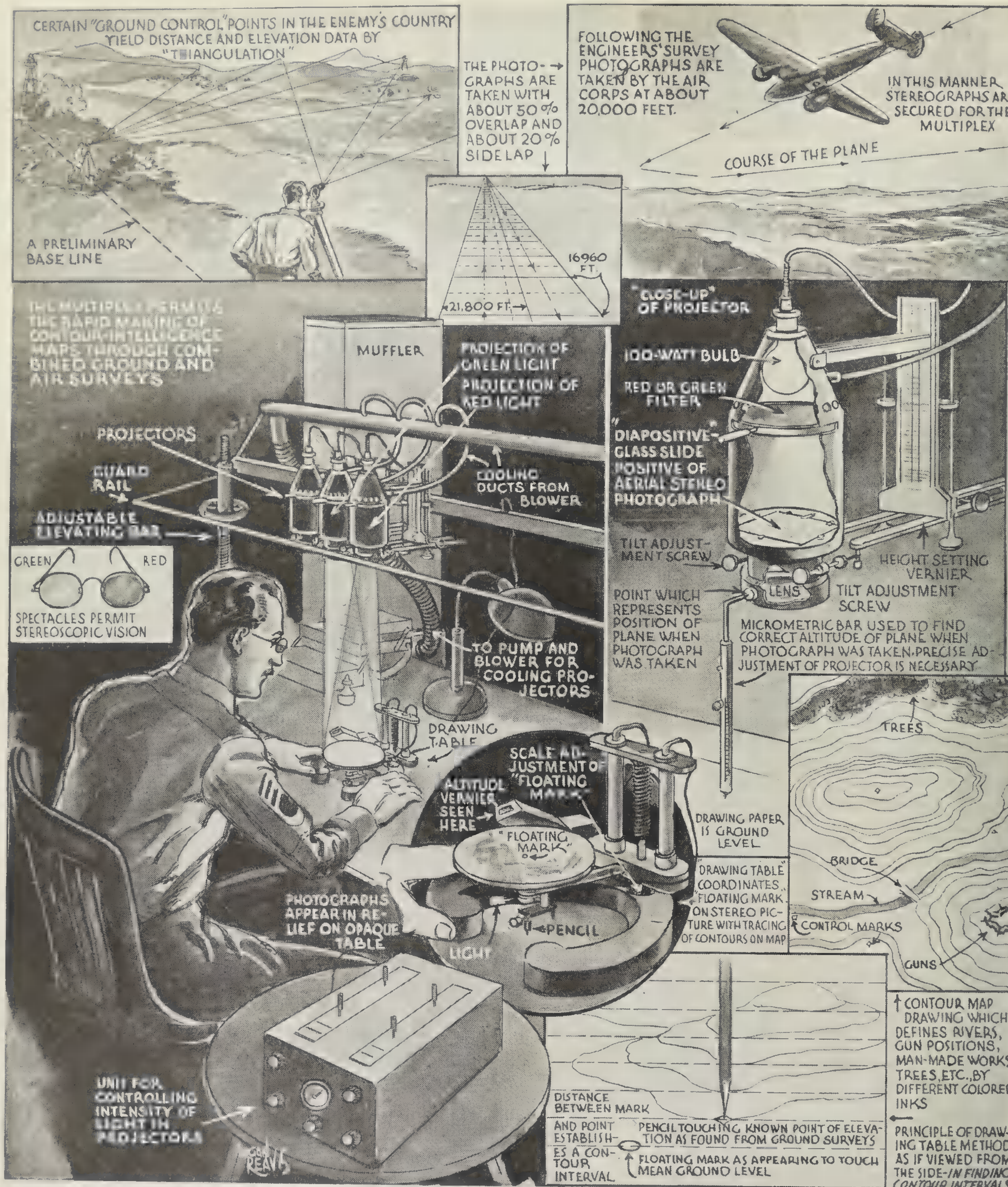
In 1916 Mr. Mason again pulled up stakes to serve his country. He was given charge of all construction for the U. S. Merchant Shipbuilding Corp., at Bristol, New Jersey. Later he went South to go into the business of extracting naval stores from sawn lumber, in which he employed a process of his own. He made his headquarters at Laurel, Mississippi.

Mr. Mason watched with interest and concern the large proportion of a tree that was utter waste in the saw mills—edgings, slabs, boards of unmarketable shape or size. Here, he thought, was a vast supply of valuable raw material going to waste. If some economical means of reducing those scraps to fiber could be found, it would be a blessing to the paper industry.

Mr. Mason found a way. He bored a deep hole in the end of a piece of steel shaft to form a cylinder. In the hole he placed clean wood chips and a little water, and then plugged up the end. He heated the cylinder with blow torches until about 600 pounds of steam pressure was generated inside. Then he suddenly released the plug. There was a roar, and the air was filled with a shower of wood fiber.

The fiber was too tough and strong to make a good grade of paper. Besides, the lignin—nature's binding cement—that coated the fiber would make the paper harsh. Instead of trying to eliminate the lignin, Mr. Mason turned it to advantage. Under heat and pressure he made the damp fiber mass into dense, smooth boards that could be used in hundreds of ways that its parent material, wood, could not, and that could withstand punishment which would destroy wood. The lignin, instead of being a drawback, served to hold the fibers together. Mason had, using nature's own materials, improved on nature. His "Presdwood" had no grain, it would not splinter, would not warp, and it had a high resistance to moisture. A new industry was born. Mississippi farmers had a new crop. Before long they were cultivating second-growth pine, heretofore of little value.

While the above article on the activities of Mr. Mason was being prepared for printing, word was received of his sudden and untimely death.—*The Editor*.



RELIEF MAPS FROM AERIAL PHOTOGRAPHS

BEFORE guns can be trained on an enemy, that enemy must be put on a spot and that spot must be on a map—a map that shows elevations as well as linear distances. Accordingly, U. S. Army engineers are employing a method of producing relief or topographic maps from stereo photographs made by the Air Corps. Essentials of the system employed are shown above. Although it is impossible to survey enemy territory from the ground, preliminary control points may be established by the usual methods. Then stereo photographs are taken from the air and, reduced to proper size, projected in the Multiplex instrument shown. Now, by means of accurate controls, the operator adjusts the floating mark so that it appears to rest on a certain level of the stereoscopic image. Then, by guiding the instrument over the drawing table so that the floating mark appears to follow points of the same altitude, the pencil attached will trace a contour line. The floating mark is then adjusted to another level, in predetermined scale, and the process repeated. The finished drawing will form a topographic map.

96TH YEAR SCIENTIFIC AMERICAN NOVEMBER 1940

RUBBER FOR AMERICA

Chemical Factories at Home, Plantations in Brazil

WILLIAM B. LANDIS

As the unsettled course of world events focuses nation-wide attention on the problems of national preparedness, the question of obtaining adequate supplies of commodities and materials essential to American national defense is under frequent discussion.

One of the most important of these materials is rubber, about 90 percent of which comes from British and Dutch possessions in the East Indies. The possibility that this rubber supply will be cut off, or at least curtailed in future years, looms as a serious threat, particularly if the rubber colonies should be seized by one of the totalitarian powers. In many circles it is believed that such a situation would have serious consequences, particularly in regard to its effect upon our national defense program.

However, the picture appears less dark for the immediate future when studied in the light of other facts. Stocks of crude rubber on hand and afloat are sufficient to meet the nation's normal requirements for nearly six months, and efforts are being made to increase this supply still further. For example, crude rubber now in transit to United States ports is approximately double the amount in transit a year ago. But in spite of these accelerated shipments, it is now too late to obtain reserve supplies of crude rubber sufficient to meet our needs, if the supply from the East Indies should suddenly be cut off.

A study of the situation reveals two possible solutions to the problem. The first is rapid development of artificial or synthetic rubber. The second is to establish supply sources closer to home.

Of these two courses, mass production of "synthetic rubber" has the greatest immediate possibilities. While real tonnage production of synthetic rubber is lacking at present, and prices are consequently somewhat higher than for natural rubber, producers of the chemical product are of the opinion that they can swing into large scale production within six to eight months, should the necessity arise.

SCIENCE IN INDUSTRY

Although no definite predictions can be made regarding price, it is thought that chemical rubber can eventually be produced at a cost that will bring it within the price range of natural rubber. This opinion is based on the low cost of raw material from which chemical rubber is made, together with the fact that mass production methods might reasonably be expected to lower the now expensive processing costs.

ALREADY factory-made rubber is serving a variety of useful purposes, especially in the automobile and aviation industries. In many cases it is not only proving a most desirable substitute for the natural product, particularly in places where resistance to oil and heat is required, but it is also replacing leather and other materials to a large extent.

In tensile strength, vibration resistance, and other physical properties, most chemical rubbers compare favorably with the natural product. Most varieties can be worked on existing equipment in American rubber factories and can be vulcanized or processed at the same speed as natural rubber.

To conserve the nation's supply of natural rubber, consumption of that product can be reduced by approximately one half, a prominent manufacturer declared recently, if the natural rubber in tire treads and sidewalls alone is replaced with a recently developed chemical rubber. Research in that direction undoubtedly will bring out still further means of conserving the nation's natural rubber supply, either by outright substitution of factory rubber for the natural, or by combining the natural and artificial products.

Obviously, any extensive use or large scale production of chemical rubber in this country within the next few months would necessarily have to be accomplished under pressure, as an emergency measure. Many authorities agree that, from a long-range standpoint, the development of chemical rubber should go hand in hand with establishment of a source of natural rubber in the Western Hemisphere. Thus the threat that rubber shipments from the East Indies may be cut off has at least served to make America realize that something must be done quickly, if no pinch is to result from the possible curtailment of the main source of supply.

That something was already being done long before foreign events took their present disastrous course is evident from the advancements made in developing chemical rubbers.

Progress has also been made toward establishing a source of crude rubber supply in the Western Hemisphere, particularly in Brazil. The Ford Motor Company has a $20,000,000 project, consisting of two plantations, under way there on land along the Tapajoz River, a major tributary of the Amazon.

This program, launched on a

In rubber-tree bud-grafting, a bud from a "clone," or family, with desirable characteristics, is grafted near the base of a healthy seedling. The graft is wrapped with waxed tape, acres of bud-grafts presenting the sight seen directly below. At bottom of page are the healthy plants long after the seedlings were cut away. Trunks near ground show the offset or angle of the original bud-graft

more or less tentative basis in 1928, and expanded to its present proportions in 1934, is scheduled for completion in 1950. It is expected to produce an average of 1000 pounds of rubber to the acre, or 76,000,000 pounds annually. Whether or not the project can be completed by the scheduled time depends upon a number of factors, chief of which is the problem of obtaining sufficient native help. In some circles it is believed that the necessary labor might be obtained through the co-operation of the Brazilian government, particularly since a number of Brazilian leaders are urging that country to do everything possible to regain at least a measure of the supremacy it once enjoyed as a rubber producer.

In that connection, it is interesting to note that the Ford rubber estates, operated under concessions from the State of Para, are located close to the spot from which Henry Wyckham, an English adventurer, smuggled 70,000 seeds of rubber trees of all varieties, 78 years ago. Planted in the famous Kew Gardens at London, these seeds produced 19,000 healthy seedlings which were taken to the East Indies and used in founding the great rubber plantations there. For his part in this, Wyckham was knighted.

Descendants of these very trees now have been brought back to Brazil to strengthen the native stocks and develop high yielding varieties. These East Indian plantation varieties, which are expected to rehabilitate the jungle varieties and make them suitable for plantation growing, are the very finest that have been developed in the Far East. They represent the fruits of an intensive program of propagation and cross-pollination which British and Dutch interests have carried on for years, to develop rubber trees with high yield and other desirable characteristics.

As a result of this research, rubber trees have been developed in the East Indies with yields running as high as 2400 pounds to the acre. Incidentally, in the rubber industry an "acre" means 100 trees, without regard to the area concerned.

When one compares the high yield of the East Indian trees with the 300-pounds-per-acre average yield of jungle rubber, one wonders why such a difference exists, especially when present-day East Indian varieties and native Brazilian trees are descended from the same stock. Botanists attribute this to selective propagation, a process similar to stock breeding methods by means of which thoroughbred horses and cattle are produced.

At the Brazilian rubber plantations, it is expected to increase the yield of the native jungle trees by crossing with East Indian trees and also by scientific planting and cultivation. For the present, the estimated yield is set at 1000 pounds per acre, although subsequent developments may change that figure.

Although many problems have been encountered in developing the estates, operations are well under way at Belterra and Fordlandia—the company's two plantations located 24 and 110 miles respectively up the Tapajoz from its confluence with the Amazon. Concessions upon which these plantations are located embrace a total area of more than 2,000,000 acres.

At Belterra, where it is expected that rubber will be produced commercially in rather substantial quantities by 1941 or 1942, more than 12,000 acres have been cleared and planted with approximately 2,675,000 rubber trees. These are almost entirely bud-grafted with high yielding clones from Sumatra, Java, and Ceylon. In rubber terminology, it should be explained, a "clone" is a rubber "family" of definite, known characteristics which have been propa-

gated by the process of crossing.

At the Fordlandia plantation, where 6500 acres have been cleared, activities are given almost entirely to experimental work and research. Here the Ford Motor Company has planted one million trees and is conducting all kinds of experiments to produce a high-yielding Brazilian clone that will be immune to South American leaf disease and will possess other desirable qualities.

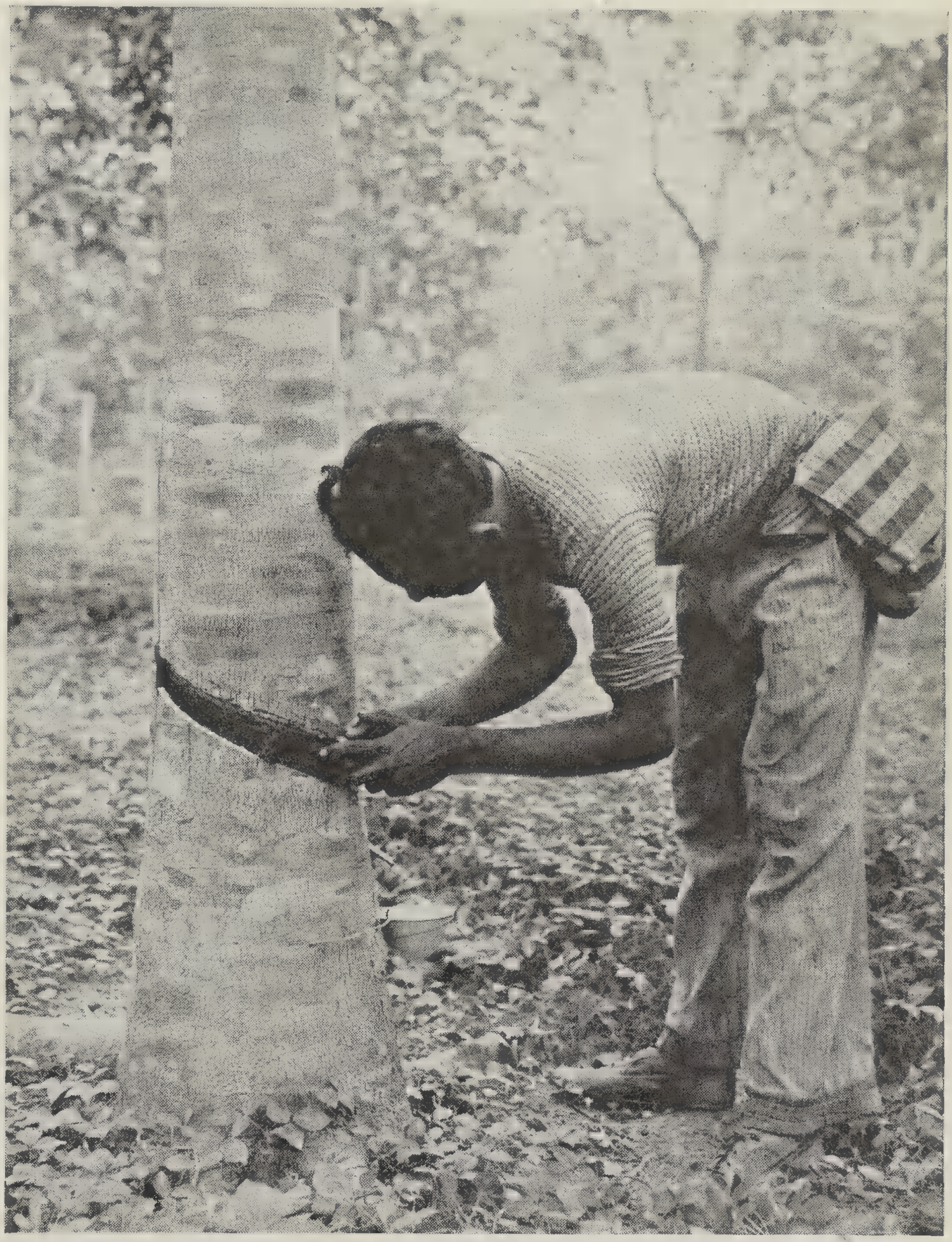
Test tappings are being taken primarily to determine what characteristics the trees are developing, but rubber thus obtained is being shipped in latex form to the Ford plant in Dearborn, where it is used in making tire fabric. In addition to developing various creaming agents to facilitate shipment of latex with a high dry rubber content, the company is also experimenting with smoked sheets, in which form a large part of the world's crude rubber is shipped.

It might be mentioned in passing that many experts regard Brazilian rubber as the finest in the world. Although the native Brazilian trees have a lower yield than their cousins from the Far East, the rubber they produce is unsurpassed in quality and is used largely in the manufacture of surgical supplies.

To combine the high quality of the native Brazilian trees with the high yield and good health of the East Indian varieties is perhaps the main purpose of the research now being done on the Ford plantations.

Crossing these varieties is accomplished in two ways: by cross-pollination and by bud-grafting. Cross-pollination produces a seed that will reproduce the dominant characteristics of the two parent trees. Bud-grafting, on the other hand, may be used to speed the processes of multiplication and also to give one tree the desirable characteristics of several others.

Inasmuch as cross-pollination and bud-grafting play a prominent role in rubber tree propagation, a brief outline of the natural process involved might not be amiss. Before they are "crossed" by insects, two trees must be in bloom at the same time. All male blossoms are stripped from one tree, and all female blossoms from the other. Bees are then placed in a cheese cloth sack, over the male flowers (from which they gather pollen) and are later transferred to the trees from which the male flowers have been removed. Crossing by artificial means is successful approximately 7 to 9 percent of the time; while when bees are used as outlined, 20 to 25 percent successful results are obtained. After pollination, the blossoms develop into seed pods, each seed containing certain definite characteristics of the two parent trees.



In tapping a rubber tree, a special knife is used to make a cut, two feet from the ground, on a 30-degree angle along half the circumference. Care is taken not to cut into the cambium layer. A spout at the lower end of cut directs into a small cup the latex which flows from the bark

Bud-grafting is done about a year after seeds are planted. Bud-patches are cut in the seedling trees three to four inches above the ground, and a bud cut from bud-wood of high yielding clones is inserted in the bud-patch of the seedling. The patch is then turned to its original position, enclosing the bud, and taped in place with a waxed bandage.

Twenty-one days after budding, the bandage is removed in order to see whether the bud is alive. If it is, the bark that covered the bud and which still adheres to the lower part, is cut off. Seven days later the budded rubber trees are again inspected. If the buds have continued well, the rubber trees that were used as stock are cut off one and one-half inches above the bud, at an angle of 45 degrees so that rain water will not accumulate. After this, the budded rubber trees are inspected monthly. Shoots that naturally appear in the cut-back trees are pruned. Trees that die are replaced.

Each acre of land thus planted contains 220 rubber trees. When these trees reach the age of five years, a yield proof is taken. That is, they are tapped to determine the

amount of dry rubber they yield. Low yielding trees are eliminated and the number of rubber trees is reduced from 220 to 100 to 150 per acre.

Maintenance of the rubber properties is itself a major problem. After the rubber trees are developed, a leguminous plant of rapid growth and high resistance is planted, 100 holes per acre, and in a short time covers the entire planted area. This is done to check the development of weeds and also to aid in maintaining the humidity of the soil.

For the operation of its rubber plantations at Belterra and Fordlandia the Ford company is now employing about 500 men. On these plantations, the company has 917 buildings, all designed to suit the various purposes for which they are intended. Good light and water facilities are provided.

Six schools are maintained with 13 teachers giving instruction to 498 children of both sexes. Hospital services are excellent, there being two hospitals with a capacity of more than 120 beds, both with X-ray and ultra-violet ray equipment laboratories, pharmacies, excellent operating rooms, plumbing and sanitary facilities, and also completely equipped dental offices.

While Mr. Ford's primary object in setting up his Brazilian rubber plantations was to establish in the Western Hemisphere a source for a large part of the rubber consumed annually by his company, the research and experimental work that has been carried on might well prove of great value to Brazil, if rubber production on a high scientific plantation basis is to replace the more or less haphazard tappings of native jungle trees.

The Brazilian government and commercial associations are now aware that the country must have good technical men if the rubber wealth of the Amazon valley is to be developed properly. Undoubtedly, the experience which Ford has gained during the past few years will prove helpful, and cooperation between these agencies should help eventually to re-establish Brazil as an important source of the world's crude rubber supply.

Pending such developments, the United States must continue to depend chiefly on supplies of natural rubber from the Far East, at least until sufficient quantities to meet our needs can be obtained from South American tappings and our own chemical rubber production.

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Dry-Cleaning Grows Up

Chemistry Stimulates Growth of the Business Into a Great Nation-Wide Industry

COMMERCIAL dry-cleaning has, within the past two decades, entered the ranks of big business. Improved chemicals used in various dry-cleaning processes, together with lowered prices made possible by these improvements, have raised the amount of cleaning done by 40 or 50 times in the past 20 years, and the amount spent for it from $55,000,000 to more than $600,000,000 per year.

New synthetic solvents have wrought great changes in the business. Non-flammable and non-explosive, they have reduced the hazards and cut the time of cleaning from hours to minutes. Scientific cleaning with the new fluids has, indeed, brought many improvements in the quality of the service that is rendered. It is this superior quality as well as speed of service made possible by the newer chemicals that has caused the prodigious growth of the dry-cleaning industry to 12,000 plants and 200,000 retail outlets.

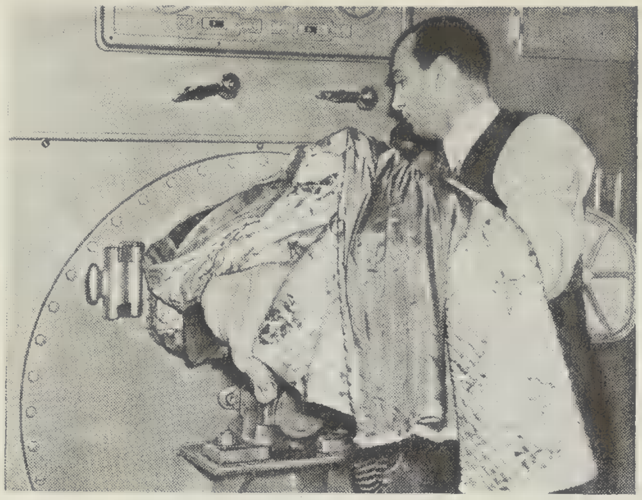
A garment is measured before the cleaning, and it must go through the process without any shrinking or stretching or alteration of original shape

Until very recent years, a garment returned from the dry-cleaner's advertised itself by its distinctive odor. In those days, petroleum distillates such as benzene and naphtha were commonly used, replacing gasoline which was used in still earlier days. About 1929, chlorinated hydrocarbons were adopted for wide use. The use of one of these, carbon tetrachloride, required expensive equipment, however, so further research was necessary. According to M. Marean, writing in the *Du Pont Magazine,* equipment costs were reduced by a product called trichlorethylene which was first employed in 1931. Two years later the Du Pont Company made it available especially for dry-cleaning purposes. This preparation is now used by cleaners in 40 states and in the District of Columbia. Another product, perchlorethylene, was later developed to meet the specific operating needs of certain systems.

Rings left by the "spotting" process are removed by spray

When you send your soiled garments to a cleaning establishment that uses these modern fluids, you can count on the sure removal of spots made by oils, fats, greases, waxes, tars, and many other substances that commonly stain fabrics. Another advantage of these solvents is that they work rapidly, requiring a minimum of mechanical action, thus saving much wear and tear on clothes. Colors become brighter, and materials regain their original feel and luster. The fluids do not cause shrinkage; silks and woolens retain their shape. As an

At the right, a quilted house-coat and several dresses are being loaded into a machine for cleaning in the modern manner with synthetic fluids. The process does an odorless job in far less time than was possible formerly. ***Below:*** **Because hand finishing and shaping are important, an evening frock is hand-pressed after being thoroughly cleaned**



extra precaution, all garments are carefully measured, before and after cleaning, to avoid any possibility of a change in shape.

After the main cleaning, up-to-date establishments carefully scrutinize all garments to see if any spots remain, for no known dry-cleaning fluid will take out all stains. Water-soluble stains, such as sugars, fruit juices, and certain pigments, usually require after-treatment, but they are easily removed by special fluids, as the general process does not set them. Then everything is thoroughly aired, and carefully pressed.

When one realizes the tremendous number of articles produced in materials that may be dry-cleaned, the benefits of quality service are more fully appreciated. According to estimates, some 550,000,000 men's suits go to the cleaners in a year, an average of a suit a month for 45,000,000 American men and boys. Women patronize the cleaner's facilities only slightly less, probably sending 400,000,000 garments a year to be dry-cleaned. Millions of window curtains, costume accessories, and upholstery covers are also included.

With the increasing adoption of modern methods and equipment, cleaning establishments are able to give all these garments thoroughly satisfactory attention, not only assuring their return in spotless, odorless condition and good shape, but preserving the strength of the materials through quick and careful handling.

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BANANA FIBER

Hemp Substitute From Skins of the Fruit

THE Formosa Development Co., a Japanese organization, reportedly has succeeded in producing a hemp substitute from banana skins. The concern plans to install 500 sets of a special fiber-extracting machine with which it hopes to produce 4,000,000 pounds of the substitute annually.

TEMPERATURE PILLS

For Production Control in Wide Heat Range

IN some metal-working industries it is next to impossible to work out a temperature control of production, especially in the black heat range. A new method, so simple that it can be entrusted to unskilled labor, has been developed by the Tempil Corporation of New York. The method involves use of small wafers somewhat like enlarged pills, different types of which melt at different temperatures. One of these, stamped plainly with its melting temperature, is placed on the surface of the metal, the temperature of which is to be controlled to an exact point. When the pellet melts, that temperature has been reached.

Tempils, as these pellets are called, are safe to use and are not corrosive to any metals. They do not pit or leave objectionable stains which cannot be easily removed. They are available in even hundred-degree ranges from 200 to 1500 degrees, Fahrenheit.

Tempils are being used to prevent cracks in metal processing; to make stronger and safer welds; to indicate the approach of safe temperature limits in the manufacture of costly castings, forgings, and machine equipment; for checking thermocouples; and for many other purposes where accurate heat control is essential.

CUTTING TOOLS

Standardized, Lowered In Price

NEWSPAPERS recently gave the impression that, because of some real or fancied hook-up with German firms, production of Carboloy in this country would be so limited as to present one of the worst bottlenecks (how that word has been worn threadbare!) in our defense program. Recent communications from Carboloy Company, Inc., indicate that Carboloy tools are not only available in numbers but have been standardized for faster production and much lower prices.

Carboloy cutting tools, as now standardized, are designed to cover 80 to 90 percent of all applications for cemented carbide tools. The simplified line comprises five styles in three different grades. They will be carried in stock ready for shipment, completely ground and ready for use—including even the grinding-in of chip breakers on tools designed for machining steel. Mass production economies will most likely decrease the amount of brazing and grinding done by organizations who at present purchase Carboloy tips to make their own tools.

A typical new standard tool costs only $1.85, as compared with a previous cost of about $5.84 in lots of one. In quantities of 50 or more, the tools now cost only 90 cents.

BACTERICIDAL

Water, Milk, Beer May Be U-V Rayed

CONSIDERABLE research has been carried on in recent years in an effort to use ultra-violet rays to kill bacteria in water, milk, fruit juices, beer, and other liquids, and there

Experimental furnace used in the development of "Endogas"

is now some promise that these efforts may be successful, according to Dr. H. C. Rentschler, Westinghouse research engineer.

Ultra-violet rays are already successfully destroying harmful bacteria and other microscopic organisms in hospitals, industrial plants, food shops, and many other places.

"Water used for pre-cooling vegetables prior to shipment," Dr. Rentschler revealed, "has been irradiated and the bacterial count reduced by 80 percent or more. Tests have shown, however, that milk and fruit juices allow only slight penetration of the radiations, hence must be treated in thin films in order to achieve material reduction in bacterial count. Beer has been found to be practically opaque to such rays.

"Seven years of intensive research involving huge expenditures, have indicated that the use of ultra-violet radiation in the field of asepsis is likely to be the nucleus of a new branch of electrical industry, open a new chapter in the field of illuminating engineering, and prove to be of inestimable value in the field of public health and industry in general."

GAS BLANKET

Prevents Burning and Carbon Loss in Steel Hardening

A NEW gas blanket protects the "skin" of high-grade steel parts against heat-burn during the hardening process, according to J. R. Gier, Westinghouse research engineer. Such fine steel products as gears, springs, bearings, and metal-cutting tools would benefit from the new gas, which has been named "Endogas."

The gas mixture answers the demand by steel manufacturers for an inexpensive atmosphere that will prevent scaling and softening of steel surfaces under heat treatment between 1500 and 2300 degrees, Fahrenheit. Loss of vital carbon from the steel can be prevented by the balancing effect of carbon in the new gas.

"Endogas" is made by mixing air with natural gas, or other inexpensive fuel gas, and heating them to 1850 degrees in an electrically heated chamber. By regulating the amount of gas and air entering the chamber, it was found, the proper amount of carbon could be sent along to the furnace to balance the amount of carbon in any grade of steel.

"OILED" SILK

Synthetic Rubber Used On Silk, Rayon

ANNOUNCEMENT of a new fabric of innumerable uses, waterproofed with a coating of a synthetic substitute for rubber which has most of the natural product's advantages without its disadvantages, has been made by the Goodyear Tire & Rubber Company. Pliosheen is the name of the new fabric.

Pliosheen fabrics, either of silk or rayon, are waterproof, odorless, tasteless, flame-resistant, contain no rubber or oil. The fabrics may be produced in the complete range of delicate pastel colors, deep tones, or clear white, all of which are sun-resistant and proof against cracking or peeling.

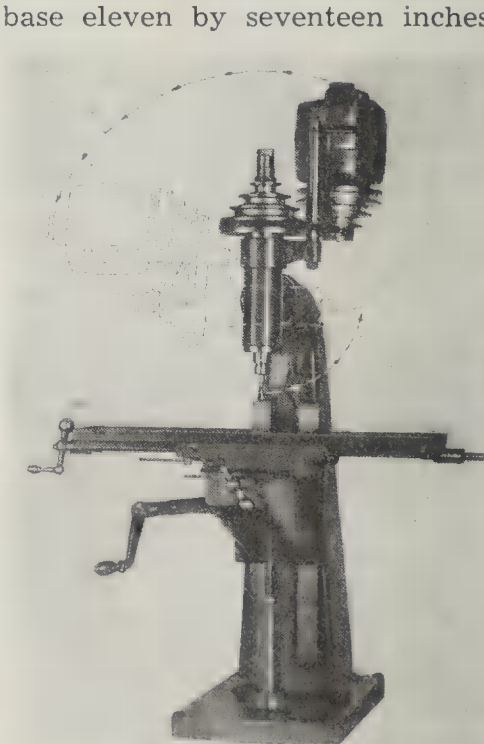
Lightweight Pliosheen fabrics are sheer and soft, but extremely strong and durable. They combine high soil-resistance with a facility for easy cleaning—a damp cloth being adequate for removal of most common stains. Pliosheen fabrics may be printed without technical difficulties, making possible an unlimited array of patterns designed to harmonize or contrast with surroundings of any specific application.

MILLING MACHINE

Univertical Bench Type With Swivel Head

A MILLING machine with a swivel head, graduated to a range of 90 degrees either way of the perpendicular, that can take over all the small jobs or about 90 per cent of the work that has to be normally done by machines costing five times as much, is announced by J. D. Duffy & Son. The Univertical high speed end milling machine is modern in every respect and capable of the most exacting precision work. It is rugged, compact, powerful; it mills, drills, and bores. Univertical mills an 8 by 16 die at one setting, and is designed for the use of cutting tools up to ⅝ of an inch. It can also be adapted to small grinding operations.

A bench type machine with a base eleven by seventeen inches,



Swivel-head milling machine

it is powered by a heavy duty ¼-horsepower motor, has a four-speed V-belt pulley, permitting a range of from 850 to 3400 revolutions per minute, handling a broad latitude of intricate milling. Its overall height is 37 inches. The maximum lift of the table to the end of the spindle is 10 inches with a work clearance of 6½ inches from the center of the spindle to the supporting column.

STERILIZATION

Process Sterilizes Animal Fibers Without Damage

A NEW process for sterilizing animal fibers and killing any disease organisms on them without damaging the fibers has been patented by three research workers of the United States Department of Agriculture. The new process will afford protection from such fiber-borne diseases as anthrax. It will also be of particular value in preventing the spread of contagious disease. The process can be used in hospitals, laundries, and dry-cleaning establishments for sterilizing blankets, clothing, and other articles that may come in contact with disease germs.

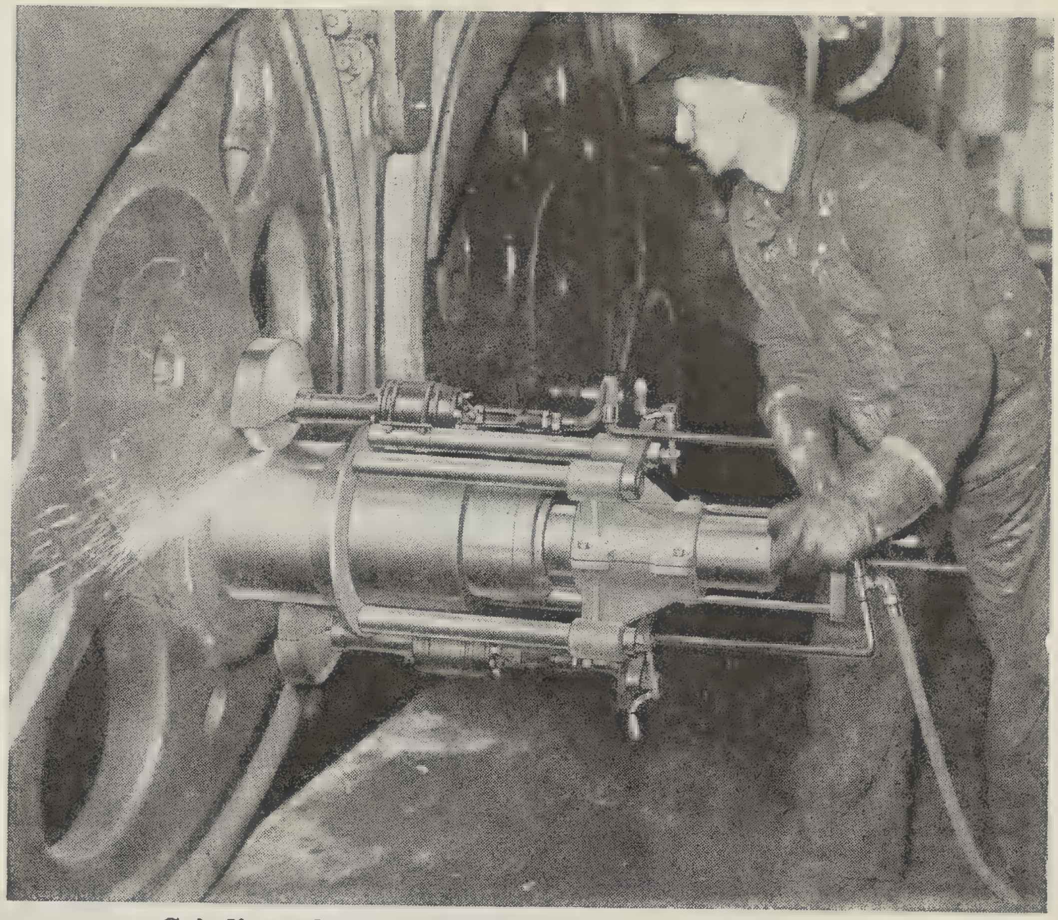
It works equally well with woven or raw fibers and with synthetic fibers made from proteins, such as the new fabric made from milk. The process cleans, disinfects, and sterilizes without injuring the keratin which is the basis of all the animal fibers. It is an improvement on current methods in the dry-cleaning industry and makes use of Stoddard solvent, a petroleum distillate of low flammability used in dry cleaning. In the new process the solvent is heated.

The newly patented process is adaptable for removing oils and fats from raw wools and permits degreasing and sterilization in one operation.

GRINDER

Grinds Locomotive Pins In Place

THE problem of refinishing locomotive crank pins has been greatly reduced in time and expense by the Milwaukee Portable Locomotive Crank Pin Grinder, a product of Goetz-Voss Corporation. The *Aluminum News-Letter* says that this grinder is mounted directly on the crank pin, and does a precision job without the delay of disassembling the drivers and putting the pin in a lathe.



Grinding a locomotive crank pin without disassembling

The grinder consists of a lightweight aluminum frame on which are mounted two grinding wheels and the necessary precision controls to resurface the pin without damage.

IODINE SHORTAGE

Germany Feels the Pinch of the Blockade

A CONSIDERABLE shortage of iodine has developed in Germany owing to curtailed imports caused by the blockade, and various measures have been adopted to restrict consumption and maintain supplies to meet indispensable requirements.

Germany is dependent upon foreign sources for all of its iodine requirements. Net imports expanded markedly in 1935, in consequence of a special trade agreement with Chile, to 228,500 kilograms from 57,600 in 1934. Subsequent to 1935, however, imports contracted steadily, falling to 126,800 kilograms in 1938, and 107,500 in the first seven months of 1939.

Residues, solutions, and other iodine-containing industrial wastes of the pharmaceutical industry plants producing inorganic or organic iodine-containing preparations, and especially the photographic chemical industry, are considered most prolific and advantageous sources for the recovery of iodine. In the case o many waste and residue materials, recovery of 98 or 99 percent is possible. Such recovery might be uneconomic in normal peace times, but costs now are subordinated to the imperative need of stretching existing supplies.

PUNCTURE-PROOF

Inner Tube for Combat Vehicle Tires

ONE thing that puzzles the layman in viewing pictures of vehicles used in warfare, is the question of why their tires are not more often punctured. The answer is that the usual type of pneumatic tire is often punctured in service by bullets. Indeed, armies of the world have endeavored to find some way of gaining the advantage of such non-solid tires and at the same time preventing their destruction by enemy fire. One of the ways of doing this is to make a sponge rubber tire. This, however, has a number of disadvantages.

A new Bullet-Seal inner tube has been developed for the tires of war vehicles by the Seiberling Rubber Company. This tube has a double thickness of small cells filled with a plastic gum and lining

the usual tube wall. The cellular structure prevents the plastic from being thrown to the outer periphery of the tire, keeps it evenly distributed throughout the inner tube. When a bullet penetrates the tire, the kneading action of the tire rolling over the ground kneads the plastic into the hole made by the bullet and effectively seals it. Tires so equipped are said to have withstood successfully a burst of shots from 30-caliber and 50-caliber machine guns.

GERMICIDAL PAINT

ANTISEPTIC and germicidal paints have long been sought by researchers. Foster D. Snell recently stated that the use of oils to which chlorine or iodine have been added produces a paint which will kill the germ of typhoid fever and some others for nine weeks after painting, and shows some but not complete killing power after six years.

FIRE WALL

Millions of "Fire-Walls" In Insulation

MILLIONS of microscopic fire-walls mixed in standard insulation constitute the newest challenge to flames which break out in one third

Testing fire-retardant insulation under blast of blow torch

of a million American homes each year. The fire walls are minute flakes of vermiculite, a non-metallic mineral which has its origin in mica. Researchers in the Fir-Tex laboratories developed a means of expanding the vermiculite flakes with heat, and then interlacing the flakes with wood fibers.

The non-metallic mineral flakes prevent the spread of flames by forming millions of fire-stops in every insulating panel. Partitions constructed with the new lath-board, covered with poultry wire and plaster, prevented the spread of fire from one room of a house to another for more than an hour. A partition of this construction also supported its normal, super-imposed weight during a fire for the same length of time.

FORGE-WELDING

Heavy Welds Made Easily as Spot-Welds

"FORGE-WELDING" is a new process of heavy-duty electric resistance welding for spot welding heavy steel and iron sections heretofore considered impossible to weld with conventional equipment.

Resistance forge-welding consists, first, in applying pressure to the work; then, interrupted current; and, finally, super-imposing a hammering action on the electrode. Under high pressure and with sufficient heat, the surfaces of work are brought into such intimate contact that when additional "impact-pressure" and intermittent heat are applied, a forged weld of superior quality is obtained.

TRANSPARENT FABRICS

British Process Increases Gloss

A NEW process has been developed by Imperial Chemical Industries (England) for making fabrics transparent and impermeable to fluids, at the same time increasing their gloss. The new process consists in impregnating the fabric with non-drying oil or semi-drying oil-modified polyhydric alcohol polybasic acid resins in conjunction with urea-formaldehyde condensation products. It is claimed that the new process eliminates discoloration and tackiness when fabrics are subjected to heat treatment for short periods of time; also that it imparts excellent flexibility, soft handle, freedom from cracking or powdering and from objectionable tendering.

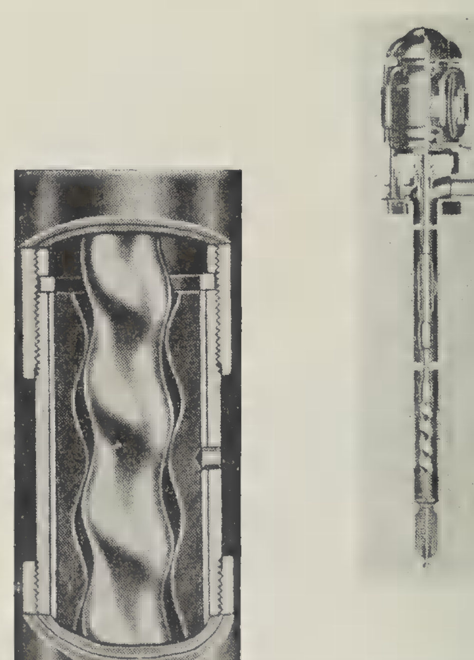
Dyed or printed fabrics may be treated as well as undyed material. The treated fabric may be subjected to a mechanical finishing treatment, and may be printed with a nitrocellulose lacquer or with a pigmented composition. The fa rics may also be finished by t methods employed in the so-call "oil-silk" trade, such as coati with shellac, and material whi has been treated locally may finished by conventional process

PUMP

Has Low Speed, High Capacity For Water

A PUMP which embodies an e tirely new principle for pumpi water, operates at the compar tively slow speed of 1760 revol tions per minute, and will deliv water against a head of 200 feet more, has been developed by t Peerless Pump Division of Fo Machinery Corporation. It can b furnished in multi-stage units when service requires it. It is particularly suitable for wells at dairies, small farms, country estates, industrial establishments, and so on.

The operating motor is on the ground level. A long connecting shaft projects downward to the actual pumping unit which is at the bottom of the well. This unit is the unique feature of the pump,



Left: **Impeller unit of the high-lift pump described.** *Right:* **Sectional view of pump and motor**

being described as a "helically contoured rotor." The rotating part is of stainless steel, and turns in a rubber stationary part having a similar shape which is called the stator. Water is lifted in amounts ranging from 300 to 5000 gallons per hour, with lifts up to 1000 feet by what the manufacturer calls "hypocycloidal" action.

INDUSTRIAL TRENDS

CORN INTO INDUSTRY

NEWS that the Department of Agriculture will open a laboratory in Peoria, Illinois, for the study of corn as an aid to defense implies an extension of work to industrialize corn which has been carried forward by many agencies for the past several years. Corn is refined to create products that have dozens and dozens of uses aside from food, and now the possibility of using it to make synthetic rubber, plastics, fibers, and motor fuel will be explored.

Last spring, yarn, buttons, poker chips, and laminated boards, made from a corn by-product, were exhibited at the National Farm Chemurgic Conference, hence the possibilities sought by the Department are not remote.

The by-product which has already produced the above mentioned articles is a protein, zein, which constitutes about 10 percent of the whole corn. Its most practical use at the moment is for coating paper. It resists scuffing and the penetration of greases and oils. Zein films are tasteless, odorless, and non-toxic. Hence they are useful for food containers. Another use is in solid-color printing using aniline dyes. It is claimed that, using zein, fugitive dyes can be made more light resistant; that bleeding dyes can be made more resistant to water. In a clear state, zein can be formulated to carry bronze and aluminum powders.

There is such a thing as a zein plastic which can be molded and, when combined with other resins, can be used for impregnating and laminating. Still a laboratory experiment is zein fiber made by extruding the protein in gelatinous form. It is claimed that its wet strength, elastic recovery, and abrasive resistance are better than those found in cellulose fibers.

The manufacture of synthetic rubber from corn would be highly desirable. With petroleum being used as a base for synthetic rubber, and corn being pushed as a source of alcohol for fuel to offset any possible shortage in petroleum, why not short circuit this performance by making the rubber from corn and leaving petroleum to serve strictly as a fuel?

THE VERSATILE BEAN

Protein fibers are being derived also from soybeans. Two companies have produced them in the laboratory; when last heard from, one of the concerns was going ahead with a pilot plant for further experimentation. But this is not the only particular which corn and soybeans have in common. The soybean has become an industrial product with extraordinary rapidity and, if progress is maintained, it may yet nose out corn in relative importance, but this will take plenty of time and research. Oil from the beans goes into soaps, paints, and varnishes. The proteins in the meal can be made into parts for automobiles such as horn buttons, moldings, and small fittings, just like any plastic. Production of soybeans in this country has multiplied 17 times in the past six years and is still expanding. Hence, as technological competition with corn proceeds, so also does production of larger and still larger quantities of soybeans.

HIGH-SPEED CUTTING

A new alloy on the market is especially designed for fabrication into cutting tools. It is significant on two counts: It represents another link in the long chain of developments aimed at the speeding up of metal cutting operations; it calls for a smaller tungsten content in its composition than is customarily found in high-speed steels. It does not fall within the classification of the tungsten carbides or tantalum carbides in hardness or cutting capacity, but is an all-purpose tool for general machine shop use, and is competitive with existing high speed steels.

Tungsten is one of those 17 strategic materials the use of which might be curtailed in event of real emergency; thus the new alloy is a real war-time product. Its tungsten content is 5 percent as compared with 18 popularly used, and, according to claims, the reduction in tungsten does not in any way impair cutting qualities nor the ease of handling during fabrication. It can be fabricated in raw form or finished tool without special precautions. Hitherto, low-tungsten, high-speed steels have been subject to severe carburization during the hardening process; hence special care had to be taken to avoid destroying the surface of the steel during processing.

FLUORESCENT LAMPS

Credit the fluorescent with one solution to a knotty lighting problem of modernization. When additional lighting is desired and no increase in wiring is possible because conduits are imbedded in construction and cannot be replaced with larger sizes, fluorescent lamps will give more foot-candles per given amount of alternating current.

PERMANENT SUBSTITUTES

Out of effort expended to find substitutes for strategic materials may come products and processes superior in quality and lower in cost than those supplanted; hence they will outlast the emergency period and win a permanent place in industry. This explains why it is good business to keep up-to-date with all new developments—it keeps one in front of the procession.

Packaging is one of the fields likely to be permanently influenced by current developments. Now being sought are metallic substitutes for tin plating, such as aluminum, silver, and tin-zinc combinations for can coatings. There are also lacquers such as came to be used in beer cans. Besides metals for packaging, some interesting products are coming on the market which employ plastics and coated cardboards with and without re-enforcements. Some will be seen on grocers' shelves very shortly.

BERYLLIUM AGAIN

This metal likes to step into the spotlight. (See March 1940, page 142.) A bill has been introduced to make it a strategic material subject to Government control, and reports have it that the War Department has tested the metal successfully for parts in the Garand rifle. There's a lot rumbling here and facts may come to light soon.

—*Philip H. Smith*

What Are Pattee's Caves?

Are They the Remains of a Medieval Irish Monastery in New Hampshire, as is Claimed?

HUGH O'NEILL HENCKEN, M.A., Ph.D., Litt.D.
Curator of European Archeology, Peabody Museum, Harvard University

IT IS now widely realized that Columbus was by no means the first European explorer to investigate the continent across the Atlantic. The Icelandic sagas tell of Norse navigators of about 1000 A.D. who visited North America, and it is no longer seriously questioned that these stories contain a good deal of historical fact. Claims have also been put forward for early Portuguese, Welsh, and Irish explorers, but on much less secure grounds.

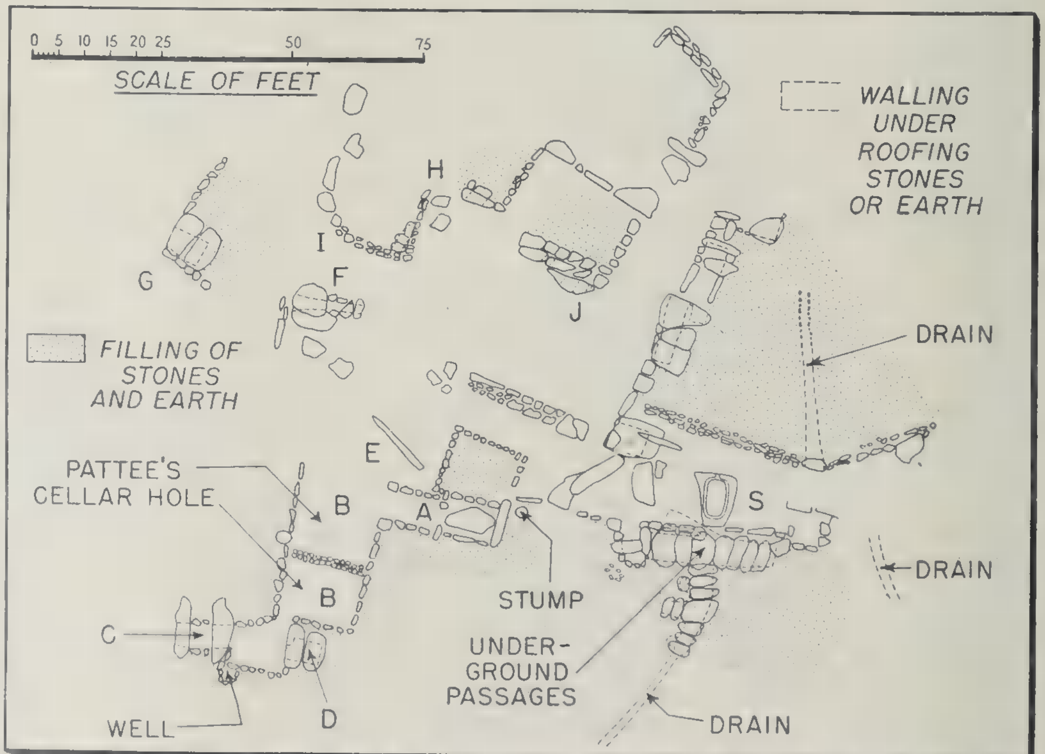
Especial interest has also attached to possible archeological traces left by these earliest transatlantic travelers. But, up to now, though numerous discoveries have been reported, those acquainted with European buildings, inscriptions, weapons, and so on, of that time have either assigned the objects to a much later date than that attributed to the early voyages or have suspected fraud. Still, one never knows at what moment the first genuine discovery may turn up.

One of the most recent claims of this kind has been put forward by the distinguished antiquary, Mr. William B. Goodwin, of Hartford, Connecticut, who has suggested that a curious group of ruins, known locally as Pattee's Caves, near North Salem in southeastern New Hampshire, is an Irish monastery. In his view this monastery would have been founded by sailor monks like those who settled in Iceland before the Norse occupation in the latter part of the 9th Century.[1]

The largest ruin, marked *B* in both plan and drawing, appears to be the cellar-hole of a New England farm house. Around it are remains of numerous rough masonry buildings with only a few patches of mortar. Some are subterranean or semi-subterranean and are roofed with huge flat stones. The walls also contain many big stone blocks.

The most remarkable structure is the so-called "Y-Cavern" (marked "Underground Passages" on the plan), a narrow, branching, subterranean passage lined with stone walls, roofed with flat slabs and provided with numerous niches and a long drain. Close to the Y-Cavern is a large flat stone marked *S* on the plan. Around its upper surface a little way from the edge there is cut a narrow channel with an outlet at one end, obviously designed to catch and drain off some liquid. It has been called the Sacrificial Stone, though, needless to say, sacrifices requiring such equipment can hardly be associated with the ritual of the Church! Comparison is suggested with the old New England lye-stones. These have such channels, though much smaller in diameter; a hogshead of ashes used to be put in the middle and water seeped through to wash out the lye. Possibly the Sacrificial Stone may be something of this sort. But to interpret Pattee's Caves as a whole is very difficult. They might conceivably have served as the out-buildings of a farm, but their size and number seem out of all proportion to the house which is known to have stood at the point *B* from 1832 to 1855, and which was not large.

THE idea that the site was really an Irish monastery as old as the 9th or 10 Century, A.D., has been suggested by a series of references in the Icelandic sagas to a country across the ocean called White Man's Land or Ireland the Great. These sagas are long prose histories of the Norwegian families who began to settle in Iceland in the 9th Century, but they were not committed to writing before the middle of the 12th Century. Some of them describe undoubtedly historical voyages to Wineland the Good (North America) about the year 1000. In these stories also occur the references to White Man's Land or Ireland the Great. This place was said to lie west of Ireland, and there are hints that it was known to or occupied by Irishmen. On the whole, however, the accounts of White Man's Land or Ireland the Great may be considered as folk-lore rather than history.



Illustrations courtesy *The New England Quarterly*

A plan of Pattee's Caverns, near North Salem, New Hampshire, which some regard as remains of a monastery, others as an eccentric's work

[1]The writer is greatly indebted to Mr. Goodwin for every kind of assistance in examining these ruins and their history, as well as for the accompanying illustrations, and it is very much to his regret that he cannot agree that these structures represent a pre-Columbian settlement.

A fuller account will be found in *The New England Quarterly*, Vol. XII, pp. 429-442.

A panoramic drawing of the same group of structures. The letters correspond in each illustration

The view that the site was really an Irish monastery was also suggested by the presumed likeness of Pattee's Caves to certain ancient structures in Ireland. Now, in Ireland, as in many other parts of Europe, there are early stone buildings of several kinds and of several different periods. But, despite a few superficial and generalized resemblances, the caves are not closely comparable to anything in Europe. If one examines Irish monasteries of the early period, one finds that there are four features common to most of them: surrounding walls called cashels, small rectangular churches, round towers, and numerous contemporary graves often accompanied by inscribed and ornamented tombstones. Not one of these occurs at Pattee's Caves. It is also safe to say that the New Hampshire site differs equally widely from Norse sites. It may further be added that the caves bear equally little resemblance to anything ever built by Indians.

What can local history tell us of these ruins? One occupant is indeed fairly well known. He was a somewhat dubious character called Jonathan Pattee, who committed a robbery about 1826 and eluded search by fleeing to this place. About 1832 to 1835 he built the farmhouse whose cellar-hole is shown here as *B* in the drawing and plan, and here he lived with his large family until his death in 1848. In 1855 the house was burned down and shortly afterward the site was used as a stone quarry.

Tradition also can add something to historical fact, though as is often the case, it complicates rather than clarifies the issue. The people of North Salem, including some of Pattee's descendents, concur in ascribing all the buildings to Pattee himself. But one of Pattee's sons is known to have said that his father did not build the structures, but "improved" them. This expression might mean in old New England usage merely "occupied and kept up." Both of these traditions may contain a part of the truth.

Mr. Goodwin, mentioned earlier, has done much to excavate and repair the Caves and in the course of this work a quantity of broken china and other objects dating between about 1790 and 1850 has come to light. Assuming that the Pattee family probably arrived with some old or second-hand household equipment, these fragments are probably the remains of their possessions, or possibly in a few cases those of some immediate predecessor on the site. But, despite suggestions to the contrary, nothing has turned up to indicate early Europeans.

There is, nevertheless, one find that may indicate that at least a part of the Caves was built before Pattee's time. Behind structure *A* there is a white pine stump 27 inches in diameter which apparently started to grow after structure *A* was built. The stump is now so rotten that its rings cannot be counted, but a comparison with the diameter and number of rings of other newly cut pine stumps in the vicinity leads to the very generalized conclusions that probably the tree began to grow before Pattee's arrival in 1826; also that it is highly improbable that it began to grow before the *Mayflower* arrived in 1620. Hence the stump suggests that structure *A* may have been built before Pattee's time. Indeed, this might explain why Pattee went there in the first place when he was a fugitive from justice. But it certainly does not prove that Pattee's Caves were built prior to the white settlement of New England in the early 17th Century. Hence one is forced to the conclusion that they were built after the white settlement.

Who, then, could have built Pattee's Caves and why? None of the objects found by Mr. Goodwin seems to be older than 1790. The age of the white pine stump, which seems to be later than structure *A*, is not necessarily inconsistent with this, since it can be fixed only within broad limits. But it would indicate that perhaps at least structure *A* was built before—but not very long before—Pattee's appearance in 1826.

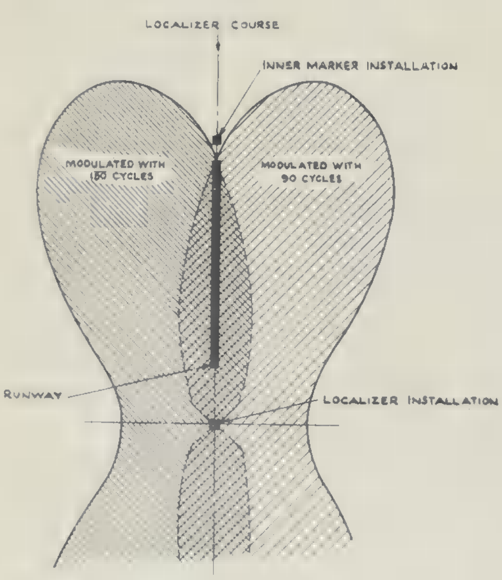
Pattee, aided by his numerous family and perhaps a team of oxen, would have had no special difficulty in building the caves. What he built them for is another matter. The people of North Salem say that he was crazy.

Blind Landing

Exhaustive Tests Show Effectiveness of System Being Installed at Six Airports

ALEXANDER KLEMIN
Aviation Editor, Scientific American. In charge, Daniel Guggenheim School of Aeronautics, New York University

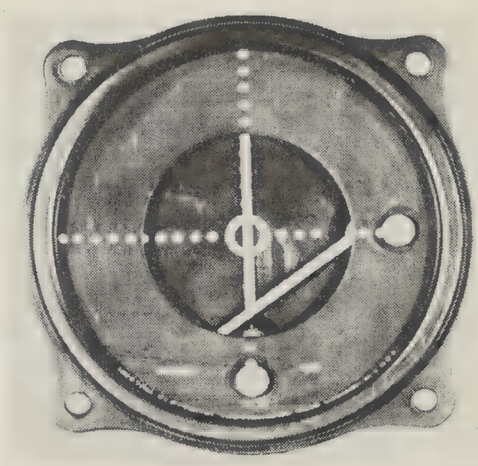
As a result of competitive bidding, and technical examination by the National Academy of Sciences, the blind landing system of the International Telephone Development Company has been accepted by the Civil Aeronautics Board, and is being installed at six of the principal airports of the United States: La Guardia, New York; Municipal Airports at Chicago, Cleveland, and Kansas City; Mines Field, Los Angeles; and Meacham Field, Fort Worth. If this blind landing system proves as effective in service as it has in exhaustive tests, our airlines will become almost "weatherproof."



How overlapping horizontal radio field patterns produce the runway localizer course

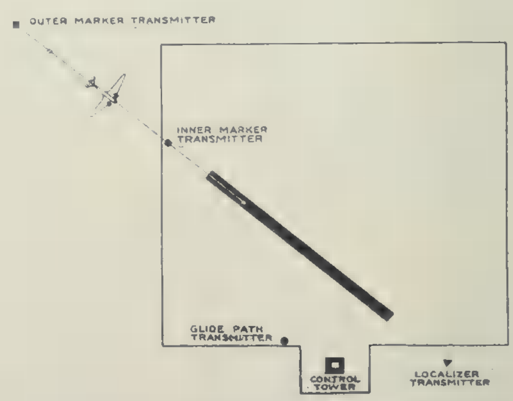
Radio navigation, with radio ranges, markers, radio compass, and so on, has been available for a number of years. It makes it possible for a transport plane to fly to the vicinity of its destination under almost any weather conditions. The more difficult problem is that of actually landing the airplane safely under conditions of low visibility. In radio navigation, low frequencies have proved fairly satisfactory. In blind-landing systems, however, high frequencies of the order of 75 megacycles are supreme and indispensable.

Why are short waves so overwhelmingly preferable to long waves? The reasons are clearly defined. With short waves, static is reduced to a minimum. High directivity is an absolute requirement, and the radio signal must not be disturbed by ground irregularities; it is only the ultra short waves that seem to be almost immune to the presence of power lines, rivers, mountains, and other irregularities on the surface of the earth. Antenna arrays are much cheaper and smaller with short than with the long radio waves.



Cross Pointer Indicator

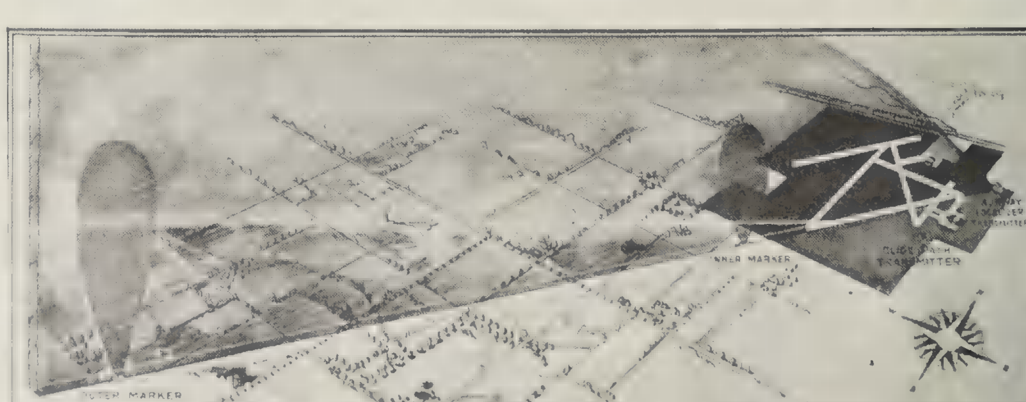
The main requirement of the blind-landing system is to provide a well-defined radio path, easy to locate, and one that will guide the aircraft in a natural glide to the approach end of the runway. To give the pilot ample time to orient the airplane in preparation for the landing, he should be able to locate the glide path some distance from the airport. The pathway meeting these requirements is analogous to a long chute sloping towards the airport. The pilot's task is to keep the landing wheels within the chute and on the floor of the chute, so to speak. Such a chute is provided by a path of constant electric field intensity beginning at a point about five miles from the airport boundary. A glide-path transmitter at the airport furnishes the ultra high frequency power for this service and a specially designed transmitting antenna establishes the constant field intensity along the path.



Layout of blind-landing equipment for use in one direction

The sides of the chute, providing lateral guidance, are given by overlapping radio fields. A runway localizer transmitter and antenna installation is located off the end of the runway at the airport. Two overlapping horizontal field patterns produce the localizer course. Each pattern is modulated with a different audio frequency and the course which the ship follows lies in the overlapped region where a signal of equal intensity is received from each pattern.

To take advantage of the path of constant field intensity and of the runway localizer, the pilot need only watch a Cross Pointer Indicator instrument in his cockpit. The



General impression of the blind landing system

vertical needle provides him with lateral guidance. The horizontal needle indicates altitude relative to the glide path. The pilot has only to control his ship so that the two needles are at right angles to one another to make a perfectly normal glide.

For further help to the pilot, two beacons are provided, located on the ground along the glide path, each projecting a narrow radio beam straight upward, to be received by the pilot as he passes by. One beacon is located two miles from the airport boundary and the other is at the airport boundary. The inner and outer marker beacons provide both audio and visual indications for the pilot. The general arrangement of the blind-landing system is shown in our illustrations. In one of them there is shown a typical layout of the four transmitters relative to the runway as installed for a single landing direction. An airport can be equipped for any number of landing directions but the maximum is ordinarily four.

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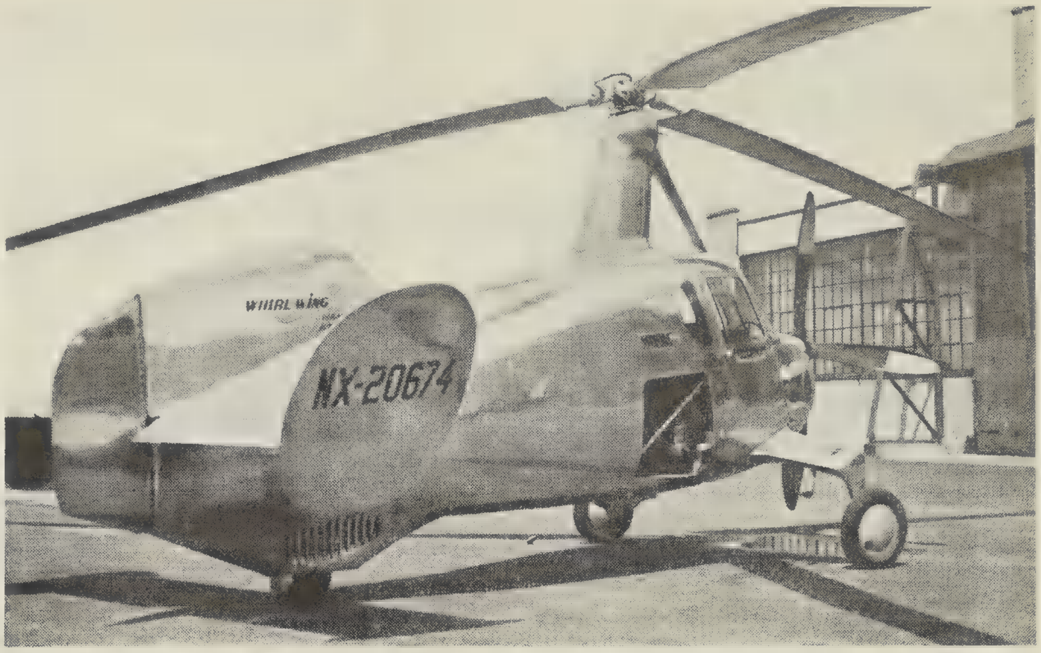
AUTOGIRO

One of our photographs shows the new Pitcairn direct-take-off autogiro achieving its remarkable initial "jump-off". The giro was placed about eight feet from two poles, 17 feet in height, which were interlaced with ribbons like a steeplechase hurdle. The path of the machine in space is indicated by the broken line.

The PA-36 is not only of the direct-take-off type, but also of the direct control type, in which control is achieved by tilting the rotor fore-and-aft or laterally, so that perfect control is available even when the giro has no forward speed. While direct control offers many advantages, bumps and other conditions, in earlier designs, transmitted rotor loads somewhat unpleasantly to the pilot's stick. These difficulties have now been removed by placing the axes of the flapping hinges close to the center of rotation.

The technique of the take-off is of considerable interest. Before the jump, through a hydraulic system, a single control lever locks the wheel brakes, sets the rotor blades at zero pitch, and engages the rotor clutch for power transmission to the rotor. Then the pilot advances the throttle, and since the blades are at zero pitch and in the position of minimum drag, they are over-revved to some revolutions per minute. By the use of the same hydraulic device, the rotor blades are then set at their normal pitch, the transmission clutch is disconnected from the rotor, and the forward propeller receives a greater torque. The rotor, now at lifting pitch but with a speed exceeding normal, exercises a lift greater than the weight of the aircraft. Hence the jump, which continues until the blades have lost kinetic energy and speed, with rotor turning at about 170 revolutions per minute.



Above: **The PA-36 autogiro, showing engine compartment with cover removed.** ***Below:*** **Line shows vertical take-off**

An interesting feature of the new machine is a fairing of rubberized fabric which covers the hub and blades, reducing hub drag and eliminating end losses at the blade roots. The blades may be folded back over the horizontal tail surfaces of the machine on the ground, to reduce hangar space required or to permit the machine to be driven down a highway.

Our second photograph indicates the general mechanical arrangement of the machine. The 175-horsepower air-cooled Warner engine is placed behind the two occupants so as to improve vision and facilitate installation of the ground drive. A drive shaft from the engine to the propeller passes forward on the side of the cabin. There are clutches for the front propeller, for the rotor starter, and for the ground drive.—*A. K.*

SAFETY

When Taking-Off From Sand

We have often quoted from the *Engineering News Letter* of Aero Insurance Underwriters. Jerome Lederer, Chief Engineer of this company, has now become Director of the Safety Bureau of the Civil Aeronautics Board, and we consider this a magnificent appointment. The last *News Letter* written by Mr. Lederer contains as usual at least one useful tip for flying safety. Thus, he points out that revving up the engine on beaches or gravel surfaces results in a sand blasting of the blade, as small stones, sand, and so on, are sucked up into the airscrew. Therefore, the engine should be revved up on an area free from gravel. If take-off must be made from sandy or gravel areas, the sand blasting effect can be reduced by opening the throttle slowly so that the increasing forward speed counteracts the suction from the increasing revolutions.—*A. K.*

Plastic Metals

New Knowledge Provides Science with Better Answers about Metals' Inner Nature

SIDNEY J. FRENCH
Assistant Professor of Chemistry
at Colgate University

WE LIVE in an age of modern plastics. There are plastic buttons, plastic door-knobs, plastic combs and plastic clothes; there are plastic toys and plastic dinnerware, plastic pens and plastic radios. With all these remarkable products we are likely to overlook the greatest plastic of them all—one known to man since time began—the plastic metals. Old as these plastics are, it is only in recent times that we have begun to understand the true nature of their plasticity and its control. What are some of the properties of these plastic metals?

To find this out let us enter the

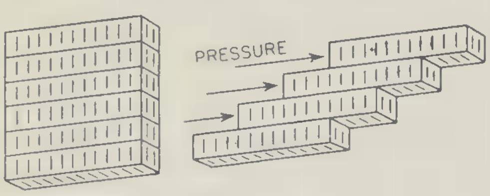


Figure 1: Left: **Diagrammatic illustration of crystal block structure of a metal crystal.** ***Right:*** **The crystal blocks echelonned**

G-man's world for a brief moment. A murder has been committed. Officers at the scene of the crime pick up an empty revolver. It is evidently the gun with which the crime was committed; but whose gun? The weapon is carefully examined for identification marks but the registration number has been laboriously filed out by the clever criminal.

Clever? No! The criminal has wasted both time and energy. The gun is taken to an expert metallographer who quickly swabs the filed spot with a suitable etching agent. In a moment the hidden numbers reappear once more. The magic of the etch has done its work; the numbers are read and the first step in the solution of the crime is well started.

What is the story back of this magical production of numbers where there were none before? Why does a simple acid solution produce numbers on a smooth piece of metal? It is all part of the story which the metallurgist calls the work-hardening of metals. It is a story of plasticity.

A friend of mine is an amateur silversmith, and a good one at that. He tells me that, as he hammers away at his silver, shaping his *objet d'art*, the metal gradually becomes hard and brittle. Soon he must stop and heat up the object, not to its melting point nor even till it softens, but merely to about 400 degrees, Fahrenheit, whereupon the silver becomes pliable and ductile once more. So he goes alternately hammering and heating till the object is finished. True, there seems to be little connection between silversmithing and restoring the registry numbers of a gun with an etching agent; nevertheless, both are phases of the same process, the work-hardening of metals.

The questions the scientist is seeking answers to are, first, what causes metals to harden and become brittle when they are worked or hammered in the cold, and second, why does mere moderate heating cause these same metals to regain their plasticity once more? Until recently, science has been able to offer no explanations beyond the mere statement that it is "the nature of the beast" to behave as it does. Now, however, better answers are being found as science probes into the intimate structures of metals.

IT has long been known that metals are made up of tiny crystals which can be observed under the microscope in a properly prepared specimen. Beyond and within these tiny crystals, where the microscope cannot penetrate, lie most of the answers to work-hardening. Each microscopically visible crystal is, in turn, made up of myriads of infinitely smaller "crystal blocks" or units, whose structures can be inferred by their effects upon the deeply-penetrating X-ray. Even then we have not reached the ultimate sub-division of the crystal, which is the infinitesimally tiny atom. These atoms are the single bricks, just as the crystal blocks are the stories, and the microscopic crystals are the skyscrapers of this tiny crystal world. Just as the stories of a skyscraper rest upon one another in uniform pattern, window above window, so too, these crystal blocks rest upon one another, atom above atom, in rows and columns, in regular pattern throughout the entire crystal (Figure 1, at left).

Another analogy: the atoms are the soldiers of a mighty company lined up in columns of fours. Within the company are the squads, each squad of eight representing

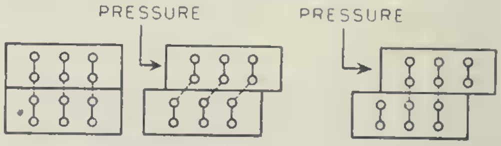


Figure 2: **Illustrating elastic deformation.** ***Left:*** **Moderate pressure, atoms stay within recall.** ***Right:*** **A permanent deformation**

a crystal block, a unit in its own right, but nonetheless an integral part of the greater unit. Each atom is alined with others of his block and each block is alined with all others of the entire crystal. This is the perfect crystal seldom found in practice.

Within the framework of the company, each squad exercises a certain degree of independence. There is an old formation in military circles called marching in echelon. At the given command each squad leader moves his squad obliquely to the right (or left) till it overlaps the squad ahead. The column is said to be echelonned in depth. This is just the sort of thing that happens when great pressure is placed on a metal crystal. Each crystal block slides past its neighbor till the whole crystal is echelonned in depth (Figure 1, right). The scientist calls it plastic deformation. If, however, the pressure is moderate, there may be no slipping beyond recall, but only a warping of atoms from their original positions. When the pressure is released, the atoms spring back into formation once more and the crystal is intact (Figure 2, left). This is called elastic deformation.

It is a well-known fact that tall buildings lean out of alinement during strong wind, yet return promptly to normal position when

the wind subsides, a good example of the elastic deformation of the metal framework. But suppose the construction were such that each story were simply set loosely upon the one below. Then it might be possible to move each story over (provided the building didn't fall down) till an upper window stood directly above a window which was formerly one space to the right. This is the sort of thing the scientist means when, in referring to metal crystals, he speaks of plastic deformation (Figure 2, right).

While all this may offer a suitable explanation of why metals may be flattened or drawn, it offers no explanation of why they harden and become brittle in the process. It is here that science steps in with its theories, none of which can yet be finally verified.

One theory of work-hardening presumes that in the slipping of crystal blocks past one another, atoms from the surfaces of each are torn loose, to be scattered indiscriminately along the slip-planes between the blocks. These mixed atoms, forming what the scientist likes to call an amorphous state, act as a sort of atomic glue causing the blocks to stick together (Figure 3, left). The farther the blocks are shoved, the greater is the accumulation of this atomic glue and the greater becomes the

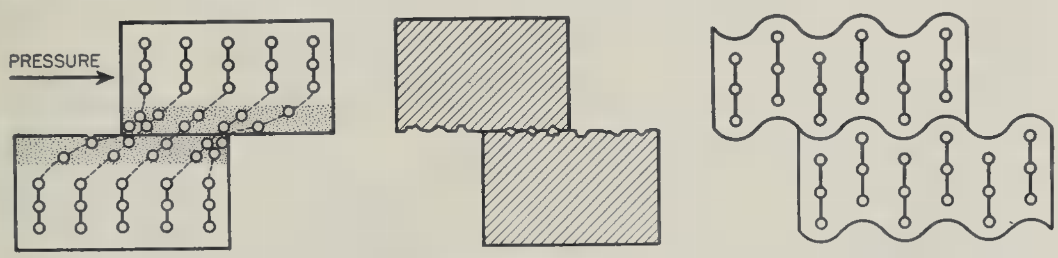


Figure 3: Left: **Illustrating, diagrammatically as before, the "atomic glue" theory.** *Center:* **The fragmentation theory.** *Right:* **The corrugation theory**

resistance to further slip. If the pressure is too great the crystal is ruptured between blocks, tearing the metal apart.

A second theory explains the phenomenon in a somewhat different way. As the blocks slip over one another, tiny fragments are torn loose to lodge along the slip-planes. Crystal blocks under great pressure break on the crystal fragments which have so effectively sanded their smooth gliding planes (Figure 3, center).

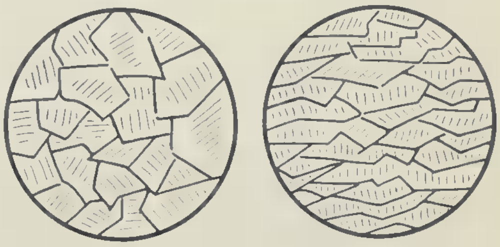
Still a third theory gives another answer to the problem. It assumes that, in the process of slipping, the blocks themselves become bent and corrugated (Figure 3, right). Try to slide two pieces of corrugated iron over one another in a direction at right angles to the ridges and valleys and you have the virtual answer which this theory, known as the lattice distortion theory, gives to the problem. As slipping progresses, the blocks become more distorted till further slipping is impossible. The limit of plastic deformation is reached.

Thus far, we have considered only a single microscopic crystal. In even a small piece of metal, however, there are thousands of these crystals, each, by chance, with its crystal blocks lined up in different directions, at all possible angles to abutting crystal neighbors (Figure 4, *a*). It is like a jumbled pile of glass bricks, except that there are no empty spaces. Suppose we shove the pile of glass bricks. Some are pushed forward; some push their neighbors sidewise, or even backward. So it is with a pack of metal crystals when pressure is put on the metal: some crystal blocks slide in line with the pressure, these in turn force the blocks of abutting crystals to slide sidewise, up, or down (Figure 4, *b*). The final net result of this jumble of slides is the same whether the pressure is a push, a pull or a hammer stroke; each crystal block is forced to its limit of plastic deformation. Then the metal breaks.

Yet, after heating, the metal is once more pliable without having lost the form into which it has been hammered. What happens to restore the pliability?

It was noted earlier that the striking tendency of the atoms is to line up in rows and columns, even when crystal blocks are shoved past one another. But this does not always happen. Often, an unhappy atom in the face of one block is forced to stop midway between two atoms of an adjacent block. Like the unfortunate neutral—between two nations at war—this atom strives to get into two positions at one time. Also, like the neutral, it is under a high state of strain. But the pressure from all sides is too great, the atom cannot move, the strain remains (Figure 5). On the surface of the metal, however, the case is different; there is no external pressure and misplaced atoms can line up in the nearest row. The surface strain is relieved.

Now we are ready to solve the apparent mystery of the gun registry numbers. These numbers are stamped into the gun under high



(a) (b)

Figure 4: **Drawing (a) shows normal crystal structure, blocks lined up in different directions. (b) shows effect of cold working**

pressure. Filing has merely removed the unstrained surface around the numbers but it has not affected the deeply strained crystals below the numbers. The etching agent removes a thin layer above the strained crystals and then attacks the crystals themselves—attacks them more vigorously than the unstrained neighboring crystals. Hence, the strained crystals underlying the numbers are most deeply etched and the numbers are reformed.

A metal under internal strain is a far from satisfactory product. The first job of heating is to relieve this strain. Atoms, even misplaced atoms in metals, are constantly in rapid vibratory motion; the higher the temperature, the greater the vibration. There comes a point in the heating of a metal when the vibration of the atoms is so great that, in spite of the internal pressure, misplaced atoms can swing themselves back into line once more. This heating, the metallurgist properly calls stress relieving or recovery. The misplaced atoms have recovered their rightful positions. The temperature required for this process is not high. Indeed, some metals "recover" at room temperature. This simply means that they do not harden or become brittle when worked, for their atoms spring back into place as soon as the working stops. Tin and lead are among such metals.

Simple recovery, however, does not restore pliability to the metal. The crystals are still elongated and distorted, as can well be observed

under the microscope. If the metal is heated somewhat hotter, a profound change, which can be followed with the microscope, begins. The distorted, elongated crystals begin to disappear, to be replaced by new, small, well-formed crystals. The amorphous atomic glue, the angular, braking fragments, the roughened corrugated crystal

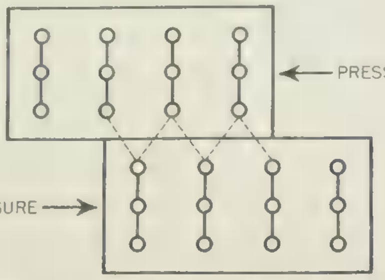


Figure 5: **Illustrating one cause of internal strain: atoms which "can't make up their minds." They do when the heat is put on**

blocks have been swallowed up in the new crystals. New glide planes have been formed. Once more the metal is willing to be flattened, drawn, or pulled to the limit of its plast-ability.

Thus does a metal pass through the phases of work-hardening and annealing. A knowledge of plastic limits, of recovery temperatures, of recrystallization temperatures, is of the utmost importance to the practical worker in metals. He knows them by instinct. But the scientist is interested in more: in the factors that motivate and promote these unique and fascinating changes in metals. He has learned much and he has much yet to learn. As he answers the whys of metal behavior, the ancient art of metal working turns into the modern science of plastic metals.

• • •

LESS FRICTION

Barium Film Lubricates Bearing In A Vacuum

A DISCOVERY that a metal film may be used to lubricate bearings in a vacuum where ordinary lubricants are useless is reported in the September issue of the *Journal of Applied Physics* by Zed J. Atlee, Jack T. Wilson, and James C. Filmer, engineers of the General Electric X-Ray Corporation.

Vaporizing metallic barium to place a film on the steel ball bearings of a rotating anode target in an X-ray tube greatly reduced the friction, they reported. Rotating anode bearings in X-ray tubes used for high power, high speed diagnostic work have been operated hitherto without lubrication.

Use of the barium as a lubricant made possible a tube which not only operates much more quietly but also is one in which the bearing life is much longer. A number of other metallic films were found to have possibilities as lubricants but barium proved to be the most successful.

In one experiment an anode bearing was observed to have a sound level of 87 decibels, a speed of 3100 revolutions per minute, and a coasting time of 12 seconds. The barium film was then applied. In 30 seconds the sound in the same bearing was reduced to 68 decibels while the speed rose to 3560 revolutions per minute and the coasting time rose to eight minutes.

Under the normal operating temperatures of the X-ray load, the film will effectively lubricate an anode bearing for 50 to 100 hours of rotation.

"OILING" OIL

Wear-Prevention by Means of Addition Agents

THE wear-prevention qualities of lubricating oil can be multiplied as much as 17 times by the addition of two groups of chemical agents, scientists of the Emeryville, California, laboratories o the Shell Development Company recently reported to the American Chemical Society.

"There are two major groups of agents," these research workers said, "which, when added to lubricating oil, are able considerably to reduce wear. These two groups have quite different functions.

"The first group consists of organic compounds whose molecules take the form of long threads which are able to attach themselves by chemical forces, arising from the special structure of the molecules, to the surface of the metal. These compounds greatly increase the tightness with which a film of oil is held between the moving metal surfaces, even under high loads.

"However, the favorable effect of such agents is lost unless the metal surfaces themselves are highly polished and maintain their high polish in service. Even the best polish attainable by mechanical means leaves the surface covered with microscopic irregularities or roughnesses, and it is in the removal of these that the second type of addition agent finds its usefulness.

"Addition agents of the second type have the property of combining, under the influence of the heat generated by the rubbing surfaces, with the surface layer of the metal to form low melting alloys. The result is that when the tiny hills on the surfaces become engaged with each other, isolated spots of very high temperature are produced at the points of contact which cause the surface layer of low-melting alloy to melt and flow just at those points where the hills come into contact.

"These chemical polishing agents are so chosen that the whole surface of the metal does not melt, nor even grow hot, but only the minute projecting roughnesses. In this way the surface of the metal is polished to a high degree while in motion and by virtue of its motion.

"Laboratory tests using highly sensitive apparatus, capable of reproducing wear measurements within an accuracy of 1 percent, have shown that the wear properties of a highly refined white oil, for example, can be improved ten times by the addition of the chemical polishing agents alone. When both polishing and 'film holding' agents are used this factor has been increased to 17 times."

SOUND ENERGY

Noise Speeds Chemical Reaction

SOUND, without assistance from any other source of energy, can speed up the rate at which a chemical reaction takes place, Dr. Walter C. Schumb of Massachusetts Institute of Technology has reported to the American Chemical Society.

Although it has been assumed by scientists that an intense sound has an accelerative effect on certain chemical reactions, Dr. Schumb is the first to prove that this increase in activity takes place because of the noise, as such, and not because of heat energy transmitted by mechanical vibrations.

Dr. Schumb and Mr. Edmund S. Rittner showed that sound energy produced by a rapidly vibrating nickel tube partly immersed in a solution is able, of itself and apart from any thermal effect, to hasten the speed of a chemical reaction. They carefully balanced out the heat effects resulting from the me-

chanical vibration of the solution so as to be able to establish the reality of the effect of the sound *per se.*

"We were not at this time attempting to widen the scope or applicability of this form of energy or to find new uses of the vibrating unit," Dr. Schumb says. "Many such applications have been reported hitherto, such as the partial sterilization of milk, the preparation of various kinds of emulsions, including photographic emulsions, and the bringing about of certain oxidation processes. The physical erosion of metal brought about when a liquid and a metal are in relatively rapid motion with respect to one another, as in the pitting of ship propeller blades, pump impellers, and hydraulic turbines, is of practical importance and has been studied with the same type of apparatus."

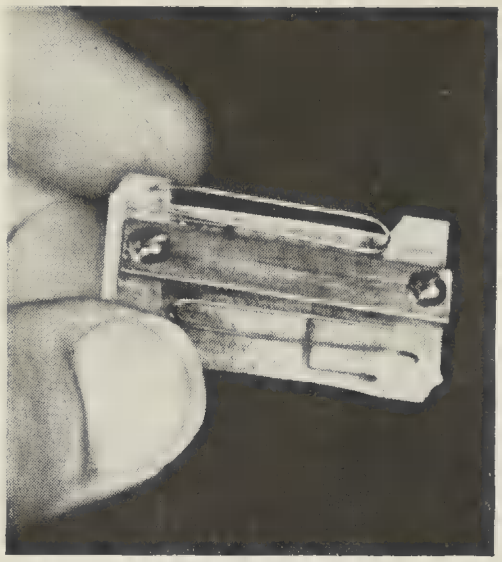
STRAIN GAGE

Small Device Permits Study of Moving Parts

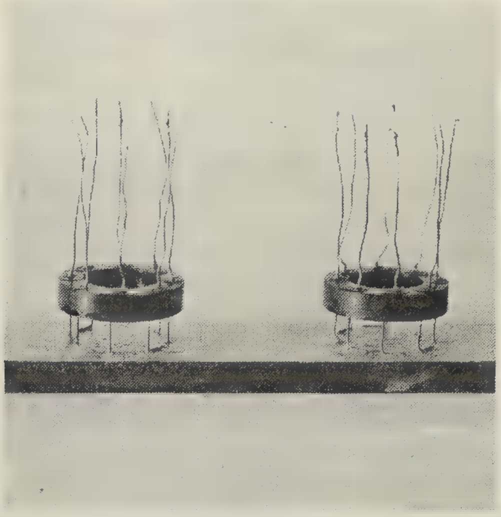
STRESS and stress distribution in such structures as the complicated members of airplanes, automobiles, railroad equipment, and bridges may now be determined and analyzed by a new strain gage. This device makes use of the fact that strain changes the electrical resistance of metallic conductors. It combines the accuracy of the testing laboratory with simplicity, convenience, and reliability. It is simply cemented to the member to be studied, has no clamps, no moving parts, no inertia distortion, and no hysteresis. Once in place, a strain gage may be left permanently installed for months during which a complete study of the part on which it is attached may be made.

The SR-4 Metalectric strain gage is simply a small grid of specially selected metallic conductors; its overall dimensions are ¾ by 1⅜ by ¼ inches. It may, therefore, be installed in places inaccessible to other forms of stress analyzers. In the accompanying photograph, the brass bar shown screwed on top is used merely for rigidity and is removed once the strain gage has been cemented into place.

This new gage is particularly suited to machinery operating at high speeds because it has no detectable inertia effects and has been tested at frequencies of over 30,000



An SR-4 strain gage



Strain rosettes

cycles per second, with no indication as to any upper limit to the response.

An indication of the wide range of application of the Bonded Metalectric method of strain measurement is in its application to the two-dimensional strain rosette problem. The strain rosette is a highly simplified instrument which is cemented as a unit to the surface under investigation. It contains four gage lines at 45-degree angles to each other, each of ¾-inch gage length. By connecting, in turn, the leads from the rosette to the control box, the amounts and directions of the principal stresses (axes of the stress elipse) of any surface can be accurately and rapidly determined.

SCAVENGERS

Gold Fish Do a Job For Research

THREE gold fish, costing 30 cents, have been put to work in General Electric's plastics research laboratory, doing the work which took seven hours' time of a chemist each week. Since the fish find food in the work they do, the upkeep or maintenance is without cost.

A large glass jar is used in the laboratory for keeping a constant temperature bath for measuring viscosity in plastic materials. The inside of this jar had a tendency to collect scum, making the glass opaque. Since it was necessary to make frequent observations of what took place in glass tubes inserted into this bath, the jar had to be emptied once or twice a week and scoured. The scum stuck, and it was a tedious job to clean it. Different acids were tried, but they didn't work. Then three gold fish were put into the jar. They took to the scum like a kitten takes to milk, and within two or three days the scum had all disappeared. That was three months ago, and since that time it has not been necessary to clean the bowl.

DISAPPOINTED

Prospector Finds Remarkably Fine Mineral; Shrugs

WHEN a Mexican prospector in the southwest stumbled on a vein of vitreous material, he leased the deposit to others, since this was not the material for which he was looking. That vein has turned out to be one of the biggest calcite deposits ever discovered. Around the borders of the schist, crystals of calcite up to 1½ feet across grew out into the clay bed.

Nothing like this had been discovered since the opening of the Iceland spar mine at Helgustadir. When the operators of the new domestic mine approached Bausch & Lomb, largest user of optical grade calcite, the company contracted to take the entire output of optically suitable crystals. The result has been spectacular. More than 500 pounds of fine spar crystals were taken out within a period of three months. Imported crystals have averaged between two and four ounces and not more than 200 or 300 pounds a year have ever entered the United States . . . none in late years. The new source, the first of any consequence found in America, adds additional protection of the optical industry.

The most important use of calcite is in the construction of Nicol prisms which are used in many scientific instruments designed both for laboratory purposes and as an aid to industry in checking the uniformity of its products.

The Origin of the Earth

Astrophysicists Still Are Unable to Solve This Near-at-Home Problem with Finality

HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

It is almost two years since Bethe published his beautiful explanation why the Sun keeps on shining. Hydrogen supplied the fuel, helium formed the ashes, and carbon and nitrogen kept the process going by a chain of reactions at the end of which they were formed anew. The only doubt that could have been raised at that time was that two of the six steps in the cycle had not yet been observed in the laboratory, but had to be inferred from the theory of atomic nuclei.

Since then, both the missing links have been supplied by experiment. Ordinary nitrogen nuclei, bombarded with protons, have been observed to form a light, radioactive isotope of oxygen, according to the equation $N^{14} + H' = O^{15} + \vartheta$ (where ϑ represents energy emitted as a gamma-ray). These oxygen nuclei emit positive electrons, and turn into heavy nitrogen, N^{15}.

This isotope forms about one part in 260 of ordinary terrestrial nitrogen. It would be hard to study were it not for the recently developed methods of concentration which produce small amounts of nitrogen compounds greatly enriched in the heavier atoms. Bombarding these with protons it has been found that the reaction predicted by Bethe

$$N^{15} + H' = C^{12} + He^4$$

is not only possible, but exceedingly probable. Every direct hit of a proton on a heavy nitrogen nucleus breaks it up. The alternative reaction $N^{15} + H' = O^{16} + \vartheta$, in which oxygen is formed and radiation emitted, is theoretically possible, but, if at all like other radiation-producing processes, must be very much less likely to occur. Bethe estimates that it will happen in only one case in a million.

Bethe's anticipations have thus been confirmed in detail, and his theory now rests entirely on observed facts. His original predictions were, indeed, too cautious, for both of the nitrogen reactions are more probable than he originally estimated. Under the conditions which prevail at the Sun's center, the average life of an N^{14} nucleus, before a collision builds it up, is estimated by Bethe as 4,000,000 years. That of N^{15} is only 20 years. For ordinary carbon, C^{12}, it is 2,500,000 years, for C^{13}, 50,000 years. He points out that "these values may easily be wrong by a factor of about three either way" on account of the uncertainty in passing from the effects of the few, but violent, nuclear collisions which are produced in our experiments to those of the less violent, but more numerous, collisions inside the Sun.

The later results are astrophysically more satisfactory than the original estimates, according to which the life of N^{14} was 50,000,000 years. On this basis, it was necessary to assume that nearly 10 percent, by weight, of the Sun's interior consisted of nitrogen in order to account for the production of energy at the known rate, at the central temperature and density, which can be pretty well estimated. The new data reduce the calculated proportions of carbon and nitrogen each to about 0.5 percent—which accords much better with the general spectroscopic evidence. According to the new calculations, however, the abundance of N^{15} in the Sun should be only 1/200,000 that of N^{14}. The heavier isotope is about 800 times more abundant than this on the Earth.

This would raise serious difficulties, if we had strong reasons for believing that the composition of the inside of the Sun and the outside of the Earth were exactly similar. But there is no such reason, except for the assumption that the Earth was in some way formed out of matter expelled in some way from the interior of the Sun, or of some star of similar composition, and this assumption, so long accepted, is now in very serious difficulties.

The high terrestrial abundance of heavy nitrogen does not stand alone. Heavy hydrogen — deuterium—is approximately 1/5000 as abundant on Earth as the lighter isotope. But the deuterium nucleus is by far the easiest of all to disintegrate. In the Sun's interior practically no deuterons should survive. Bethe estimates their number as certainly less than 10^{-18} that of the protons—one to a billion billions. Moreover, terrestrial rocks contain small, but by no means negligible, amounts of lithium and beryllium, whose nuclei are the next easiest to break up, and would exist in only infinitesimal proportions inside the Sun.

We have here, not a difficulty with the otherwise well-established theory of the source of stellar energy, but something much more interesting and important. We are apparently led straight to the conclusion that the matter which now forms the Earth (or, at least, its accessible exterior) has never been buried deep inside the Sun, or any other star. Moreover, the same can be said about the surface layers of the Sun itself, for its spectrum shows lines of lithium and beryllium, faint but identifiable without question; showing that here, too, these fragile atoms must be vastly more abundant—perhaps it would be better to say, less rare—than in the Sun's interior.

"Never" is a very bold word to use in a scientific statement. In its stricter sense, it is clearly not permissible, for it would mean that our statement was valid throughout an infinite past—which of course goes far beyond the limits of physical reasoning. If, however, we interpret "never" to mean "not while the universe of stars has existed in its present general state," we can go far to justify its employment. Our reasoning is based on three things: First comes the undeniable fact of the existence of deuterium, lithium, beryllium, and soon, on Earth. Second, we have the easily disintegrable character of their nuclei, confirmed by numerous quan-

titative experiments. The conclusion that the mean lives of nuclei so easily disintegrated would be very short under the conditions which prevail in the Sun's interior appears to be very well founded. The third pillar of the argument is the conviction that no process exists by which these light nuclei could be built up at such a rate, inside the Sun, that they might exist there in considerable abundance, despite their rapid decay. This proposition involves the familiar difficulty of proving a negative, and is, at the moment, less conclusively based than the other two. But the number of ways in which these light nuclei could be built up out of lighter ones is strictly limited, and they have all been very carefully considered by Bethe with negative conclusions. That they could be formed by some sort of fission of heavier nuclei appears to be exceedingly improbable, for their available "packing" energy (per unit of mass) is high, while that of the heavy nuclei is low—so that such a process would have to be fed heavily with energy to keep it in operation.

We must inquire whether a mass of very hot matter inside a star, containing very little of these light nuclei, might not reconstruct them out of the hydrogen present within it, if it were removed and allowed to cool. But this would demand that, at some intermediate temperature and pressure, the atom-building processes greatly outran those of disintegration — which raises the difficulties just mentioned, in an aggravated form.

Unless—or until—some way out of this *impasse* can be found, we appear to be shut up to the conclusion that the presence of these light elements on Earth and in the Sun's atmosphere is a survival from some primitive state of the universe, perhaps antedating the existence of the stars. We must conclude, also, that there has been little or no mixing between the Sun's surface layers and its deep interior. Our present knowledge of stellar constitution does not forbid belief in this, though it by no means demands it.

Accepting this, there are various possibilities regarding the origin of the Earth (and presumably of the other planets).

1. The Earth may have been formed from the outer layers of the Sun (or of a companion star, as Lyttleton suggests), which retained, or retained in part at least, its original chemical composition.

2. The Earth may have been formed from the Sun or some other star at an early stage in the star's history, when its interior was cool and the light elements had not been broken up.

These suggestions have recently been made by Professor Bethe. We merely add:

3. The Earth, planets, and Sun may have been formed at some early epoch out of similar material, leaving the light atoms to be exhausted in the Sun's interior, but not elsewhere.

Bethe comments that, although there might be very little intermixture of the superficial and deeper material in an isolated and quiescent star, this "seems not very likely at the time of a catastrophe such as the formation of the planetary system." The question whether the brief but intense heating of the filament of matter swept off by a grazing collision of two stars would lead to the complete disintegration of light nuclei would deserve careful study, were it not that Spitzer's work has made it very doubtful whether such a filament could condense into planets.

This difficulty applies with equal force to the assumption of an encounter with the Sun in a primitive low-temperature state. The additional objection that the Sun probably remained in such a state for a relatively short time, and that it is correspondingly improbable that it should have met an encounter in this interval, is less disturbing — for it is well known among mathematicians and philosophers that there is great danger of fallacy in attempting to reason about the *a priori* probability of a single event. The assumption of a common and substantially simultaneous origin for the Sun and planets out of pre-existing material fits in well with the theory of the expanding universe, in Lemaître's form. If, during the initial stages of the expansion, all existing matter was crowded into a volume very, very much smaller than it occupies at present, then—as Bethe says—"such a freak event as the formation of the planetary system could have occurred more easily."

How it might have happened, no one yet dares to discuss in detail: but the immense turbulence which would attend the early stages of Lemaître's process offers possibilities which could hardly be met with elsewhere.

But how did the more fragile atoms get there, anyhow? This question, which will not down in our minds, takes us to the boundary of the speculative—but not farther than we may properly follow it for a few moments.

The theory of nuclear changes inside the stars, in its present state, accounts for the production of atoms of only one kind—the inert and uninteresting helium. Whether hydrogen is consumed, by Bethe's cyclic and catalytic process, or lithium, beryllium, and boron by what appear to be one-way, irreversible reactions, helium is the end-product. The light atoms, except helium, are consumed; and, despite a very careful search of the possibilities by Bethe, no way of building up atoms heavier than oxygen, or perhaps neon, has been found. Hence we must accept as a part of the initial data of the problem of stellar energy the presence not only of the light atoms, but of the heavy ones, which form considerably more than half of the mass of most of the stars.

Most of these, so far as we know, might have existed indefinitely in their present proportions, since, even inside the stars, their nuclei will not undergo sufficient violence to produce changes in them. But the heaviest atoms of all—thorium and the two isotopes of uranium—are radioactive, and decaying steadily. There seems to be no chance at all of building them up under the conditions which prevail inside the stars. If they ever had still heavier parent atoms, these must have had shorter lives than their own (since they do not survive). For their formation, we must look to some state much more radically removed from the present than exists anywhere inside the Sun.

It has been suggested informally by Bethe and others that these atoms might have been built up along with all the intermediate ones in an enormous mass of matter at a very high temperature (something like a billion degrees) and a fairly high density. Whether something of this sort happened at the very beginning of the expansion of the universe, we do not know; but, apparently, if we wish to make sense of what we do know, we must carry our speculations as far back as this. It would not be easy to go farther.

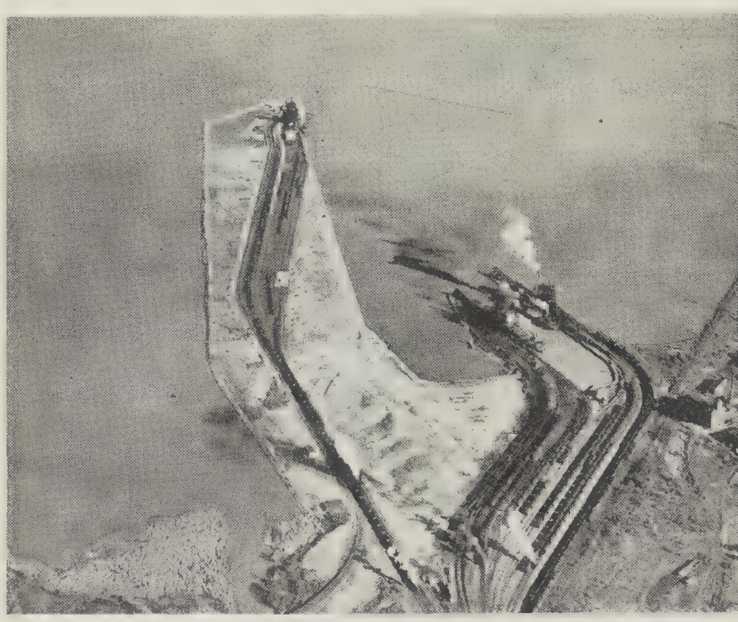
Dumps a Car a Minute

Engineers Construct World's Greatest Scientific and Speedy Coal Car Dumper

L. T. HENDERSON

PROVIDING car-to-ship coal handling equipment unsurpassed anywhere in the world for volume and speed, and increasing its already extensive facilities on Lake Erie at Sandusky, Ohio, the Pennsylvania Railroad recently placed in operation a new machine on a mile-long dock, with yards and supporting features, costing altogether $4,250,000.

With its other two dumping machines working at near capacity season after season, the Pennsylvania Railroad decided to build a third machine, the equal of which never before had been constructed. The new dumper empties cars at the rate of 60 an hour and, together with the railroad's two older machines, makes Sandusky one of the greatest centers on the Great Lakes for the transfer of coal from railroad cars to vessels. All three machines are of the lift-and-turnover type, the new dumper being electrically operated, while the older two operate by steam.



New mile-long dock and giant car-dumping machine are at left. Yards are below foreground

In addition to its important new facilities on land, the railroad constructed a new channel in Sandusky Bay whereby the vessels serving this port could be handled to and from the railroad's coal-dumping equipment with a minimum amount of maneuvering. The Sandusky coal-handling docks, conveniently situated as they are, provide an outstanding outlet for coal moved by rail from the southern coal fields through the Columbus, Cincinnati, and Louisville gateways.

The docks and extensive supporting yard facilities are situated in the western part of Sandusky and the distance from the receiving yard on the south, through the classification and storage yards, to the outshore end of the newest of the three docks on Sandusky Bay is nearly five miles. The yards have a total capacity of 7800 cars.

The latest developments in car-dumper design have been incorporated in the new No. 3 machine, with numerous automatic features for controlling and correlating the various operations necessary for swift, efficient, and careful handling of coal from the yards to the ships. The powerful machine lifts with ease the largest coal car—fully loaded—dumps the contents into the ship's hold, and returns the car to its original position, all in less than a minute.

Loaded cars for the dumper are moved from the loaded car yard to the "ready" point at the foot of the inclined approach track of the machine by electric pusher locomotives. Four of these powerful electric pushers are in use in the dock yard, operating on narrow gage tracks alongside the yard tracks. As each loaded car is placed at the "ready" point, its wheels are engaged by a spring-type, constant pressure, car retarder which prevents it from moving until a unique conveyor, or barney (dock employes call it the "pig") contacts it from a pit beneath the loaded car and pushes it forward up the 15 percent incline and onto the elevating cradle of the dumping machine. The cradle is equipped with a pneumatic car retarder which stops the car in the desired place before it is elevated for dumping.

The "pig" (or barney), pulled by a cable hoist, pushing car up into No. 3 machine

AS the car rises, it is automatically moved to the dumping side of the cradle on a movable platform, and heavy steel clamps press against the top of the car, holding it securely as it is tilted to dump its load of coal onto the machine's pan.

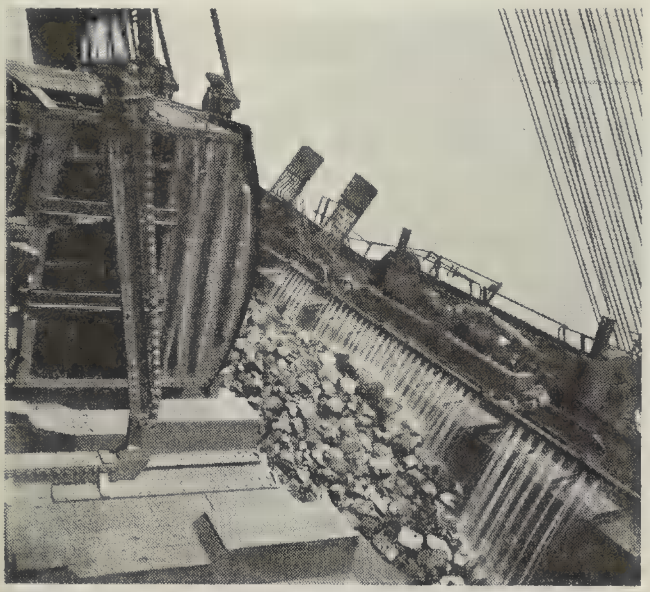
As the coal is transferred from the car onto the pan, an automatic, rubber-faced, coal flow retarder of the movable baffle type controls the flow of coal by backing gently before its load, easing the coal into a telescopic chute for placing in the boat, which is tied up beneath the chute. The combination gate and trimmer at the lower end of the telescopic chute are controlled so expertly that the coal is practically laid in the hold of the vessel. This careful handling prevents dropping or bouncing, and the coal reaches the hold in as good condition as it was in the car. The machine has a high-

pressure water line to dislodge any coal adhering to the bottom or sides of the car.

Another feature of the dumping operation is the automatically-controlled sprinkling equipment mounted on the coal flow retarder, which moistens the coal to the exact degree specified by the coal shipper or receiver.

Immediately after the car has been emptied and returned to its original position on the cradle, it is pushed off by the next loaded car and descends a 7 percent grade leading to the kick-back trestle, which reverses the movement of the car and sends it, by means of a spring switch, onto the lead to the empty car yard. However, before entering the empty yard, which is on a 0.45 percent descending grade, the car passes through a pneumatically-controlled car retarder, which regulates its speed.

The kick-back trestle of the new dumper, and, beyond, the loaded-car and empty-car yards



Moving from car, left, to pan, the coal is sprayed to regulate moisture content

Three operators control all movements of the car. One is in a cabin on the approach side of the tower of the machine at a level 12 feet above the cradle. This operator controls the barney, or "pig," and the car retarder on the cradle, and also starts the cradle in its lifting operation. Another operator, in a cabin at a point above the pan, controls the cradle hoist, the pan and the pan girder, the sprinkler system, and the flow retarder. The third operator, stationed in a cabin at the outer end of the pan. manipulates the pan, the chute, and the trimmer gates, and also the controls for raising and lowering the pan girder. The operators' cabins are connected with each other and with the dispatcher's and foreman's offices by telephone, microphone, and loudspeaker equipment.

The barney moves up the incline with a loaded car at a maximum speed of 11 miles an hour and returns to the pit at a maximum speed of 17 miles an hour, making the round trip in 55 seconds. The cradle's complete dumping cycle is 48 seconds.

Electrical power for the dumper is provided by a power company in the form of three-phase, 60-cycle current at 23,000 volts, which is reduced to 2300 volts by a substation on the premises.

The new dumping machine is situated 585 feet from the outshore end of an earth-fill dock which is 4500 feet long and 600 feet wide and represents, in itself, one of the greatest construction projects undertaken in the Middle West in recent years. Along the westerly side of the dock, the fill material is retained behind a stone revetment, while on the easterly side, which is the loading side, a steel sheet-pile bulkhead of cellular construction was built and surmounted by a reinforced concrete dock wall. A total of 9¼ million pounds of steel sheeting went into the construction of the rock-filled cells of the dock wall and more than 2¼ million pounds of steel piling support the concrete cap which tops the cells and forms the floor of the pier. The piling was driven to solid rock. The dock wall and foundation for the car dumping machine required 14,000 cubic yards of concrete.

A new ship channel was dredged, requiring the removal, by the hydraulic process, of 2½ million cubic yards of soil. Nearly two-thirds of the soil removed was used to fill in the area between the dock wall on the east and the dike, approximately 600 feet to the west; and on this made land are the new dumping machine, yards, and other supporting facilities.

The new dock yard has a capacity of 550 cars—350 in the loaded yard and 200 in the empty yard—and was planned to provide for future development, even to the installation of another car dumper, complete with supporting car yards.

The channel work included a new 400-foot dock channel, 22 feet deep, along the east side of the dock, a new approach channel 300 feet wide, 22 feet deep and 8000 feet long, parallel with the original ship channel, and 3000 feet bayward therefrom, connecting with the entrance channel to Sandusky Bay, near Cedar Point. Thus was formed a loop which permits vessels to enter the slip along the new dock via the original channel and to leave by means of the new channel. Ships loading at the No. 1 and No. 2 coal dumping machines also use the new channels, thereby expediting the maneuvering of the boats.

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NITRIDED STAINLESS

To the corrosion resistance and strength of stainless steel has now been added surface abrasion resistance by the process of nitriding. The new nitrided stainless steel is being adapted to steam valves, in textile machines, for parts in oil well pumps, and the like.

CANTONMENTS

Extensive Engineering Necessary In Building Camps

The country is launched upon one of the largest single engineering jobs it has undertaken for many a day. It will build at high speed

numerous camps for our National Guard and conscripted armies.

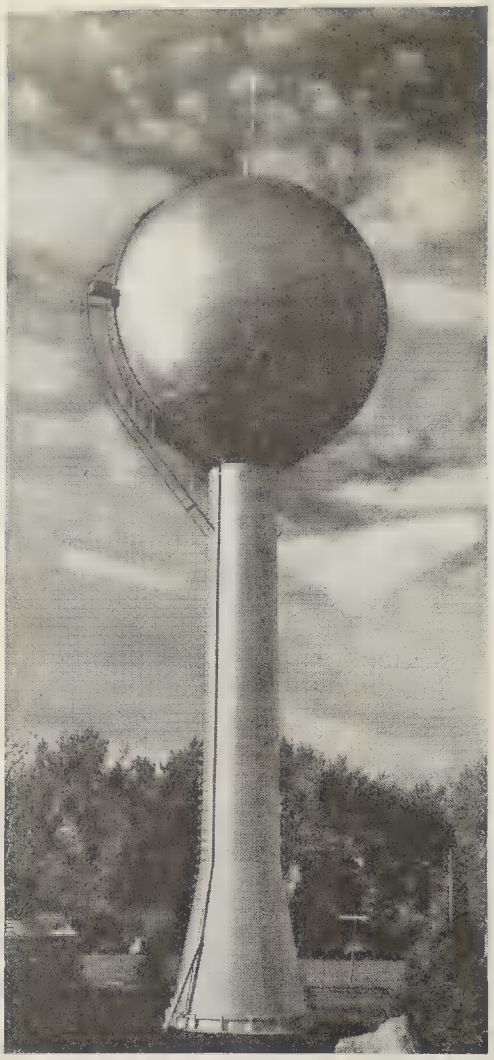
We are inclined to overlook the fact that there is more to a Conscription Law than mere passage by Congress and registration and drafting of men. World War camps and other sites will be cleared of stands of scrub timber and of the evidences of cultivation. Speedy work must then be done with excavators, tractors, and trucks, in preparing foundations, paved streets, street lighting, and all the numerous facilities required. Where semi-permanent barracks are being constructed, they will more often be two stories and (World War Veterans take note!) will be equipped with heat, shower, and toilet equipment.

Cost of temporary barracks at army posts is expected to run to more that $350,000,000. Many hundred millions of board-feet of lumber will be required as well as proportionate quantities of cement, bricks, electric wiring, and the like. It is believed that World War construction mistakes will be avoided.

BALL TANK

Sphere, For Water, Tops Enclosed Tower

THE photograph on this page does not show the beginning of construction for a World's Fair; it is one of 10 water tanks of the balanced-ball-on-pin design that have been built by Chicago Bridge & Iron Company. This particular tank was built for the town of Longmont, Colorado, and has a capacity of 100,000 gallons of water. Height is 60 feet to the bottom of the sphere. Others of the type have been built with greater water capacity and considerably higher than this one.



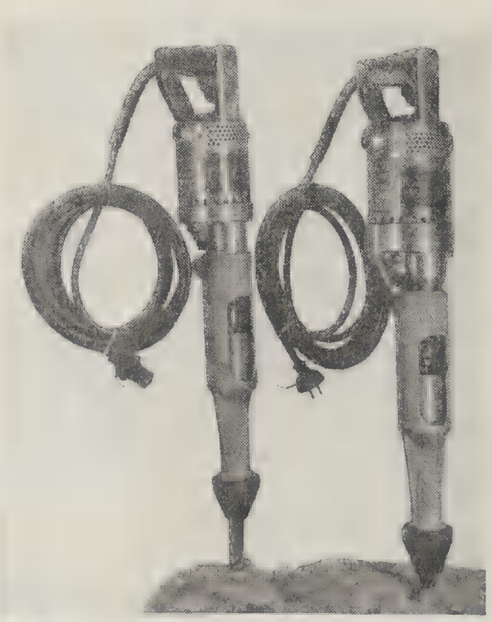
. . . 100,000 gallons of water

ELECTRIC HAMMER

Development Presented Special Problems

ONE of the things that has made American industry great is the fact that our engineers like nothing better than to tackle and lick a tough problem, whether it be in design, production methods, or materials. In the manufacture of portable tools, the electric hammer has been one of the most difficult to make.

Twenty years ago the Wodack Electric Tool Corporation set itself the task of manufacturing an electric hammer for drilling concrete, and has been at it ever since, says *Nickel Steel Topics.* A simple and practically trouble-free hammer mechanism has been evolved, but due to the terrific strain on the hammer parts in striking 2400 blows a minute, the greatest problem to solve was in finding a sufficiently strong and shock-resistant alloy steel and heat treatment that would give a reasonably long life to the working parts. A nickel alloy steel supplied the final solution of the problem.



Representative models of the electric hammer described here. The hammer-holding chuck can be seen through the case hole

The outstanding feature in the design of the Wodack "Do-All" electric hammer is that by loosening a cap screw and opening the chuck, the hammer member is removed and the power member can be used as an electric drill and grinder. The hammer drills holes in concrete and masonry as large as 1⅜ inches diameter and the drill has a rating of ⅜ of an inch in metal. The "Do-All" finds its greatest use in the building construction field but it is also extensively used as an industrial maintenance and installation tool for drilling holes for expansion bolts and screw anchors.

COUNTY MAPS

Show All Rural Structures In Most U. S. Counties

A NEW kind of county map, showing all highways and all structures in rural areas, will soon be available through state highway departments. Drafting work on sheets covering 2741 counties — or approximately 90 percent of the counties in the United States — has been completed. According to the Public Roads Administration, such maps will soon be completed for all counties in every state and many of the state highway departments already have them available for general use.

Their details range from the railroads, highways, roads, and bridges to the separate dwellings, farm units, and stores and industrial plants in the rural areas. Distinction is made between occupied and vacant structures. Streams actually navigable are shown. Also shown are such details as schools, hospitals, churches, cemeteries, camps or lodges, oil and gas wells, mines and quarries, power plants, radio stations, and air fields.

These maps are being used by business organizations and government agencies in addition to their use in highway planning. In 29 states, they were used by the Census Bureau for laying out the field work of the enumerators employed in the 1940 census and in fixing boundary limits around the settled areas of un-incorporated urban communities of 1000 or more population.

Life's Debt to Death

Nature's Attempts to Circumvent Death in Her Species May Suggest Conscious Purpose

EDWIN R. BOGUSCH

THE moment an organism begins to live it starts its relentless struggle against the forces of death. Every phase of its living existence is an expression of its effort to outwit nature, for in the plant and animal world there is no divine right to life. That belief exists only in the imagination of man.

The survival of the individual is unimportant in this battle for existence. The perpetuation of the race supersedes in importance the life of any single member of that race. Under the stimulus of approaching death living beings hasten reproduction to levels of activity abnormal to the species.

When that plant curiosity known as the agave or century plant has completed its normal span of life it produces root-sprouts at its base even before the giant flower stalk saps the last of the vital energy of the plant in its culminating triumph of reproduction. But, should something injure a normal, vigorous century plant still young and far from maturity, the plant responds with amazing concentration of energies to produce root-sprouts and provide for another generation. The activities of gnawing animals or fungi upon the roots stimulate the adjacent region to the growth of buds and new plants.

Some of our common trees, like the black locust, are so prolific in this type of response to root injury that even any interference with the normal flow of the vital water through the roots will result in root-sprouts. Just the shrinking of dry soil about the roots, that may strain and tear the tissues, stimulates this development. Botanists call this wound-stimulus. The result is an apparent effort of the plant to perpetuate the species even before the certainty of approaching death becomes established.

Similarly, when yeast plants fermenting in the bottom of a brewer's vat are subjected to higher than normal temperatures, the yeasts stop growth and undergo an entirely different physiological process. The cell contents separate into an even number of rounded bodies, each with an individual membrane. Later, when the mother cell breaks down and disintegrates, the newly formed spores are set free. Each is now a resistant individual capable of withstanding sustained high temperatures, extremes of desiccation, and even freezing; each can under optimum conditions resume life again where the parent cell was forced to stop.

AMONG the lesser forms of plant life, such as the molds and other fungi, when food becomes scarce further growth diminishes and the plant body expends its remaining energies in the production of reproductive spores. In stagnant ponds where green and blue-green algae abound, summer temperatures evaporate the water, concentrate the minerals, and stimulate rapid sporulation to guard the continuity of the species even though the parent must of necessity die.

Indeed, it is now believed that our animal and plant life has so abundantly survived because it adapted itself to seasonal conditions ahead of the time that those conditions were felt. Where the migrating bird flees southward in autumn because it must live to carry on the species to nesting time, plants developed an annual seed habit. That seed in which the tiny plant embryo nestles dormant and unaffected by winter owes its existence to the fact that the parent plant devoted all its energies to producing those seeds before frost, instead of storing an accumulation of food in its own roots for another season's growth.

Conversely, certain species commonly believed to be of tropical origin, such as the banana and the canna, have nearly or entirely lost the seed habit in the warm tropical environment, where seasons have no extremes and where the need for a dormant, resistant propagule is no longer felt.

So definite and close is the response of certain plants to factors associated with seasonal change that even the length of the day will have an immediate effect upon a particular generation. Thus the poinsettia, which normally flowers at Christmas time, may be made to produce its highly colored blossoms in mid-summer if the length of the day is artificially shortened by darkening the plant a part of each day. Likewise, in the case of the Mammoth strain of tobacco.

How the century plant doubly insures the perpetuation of its species

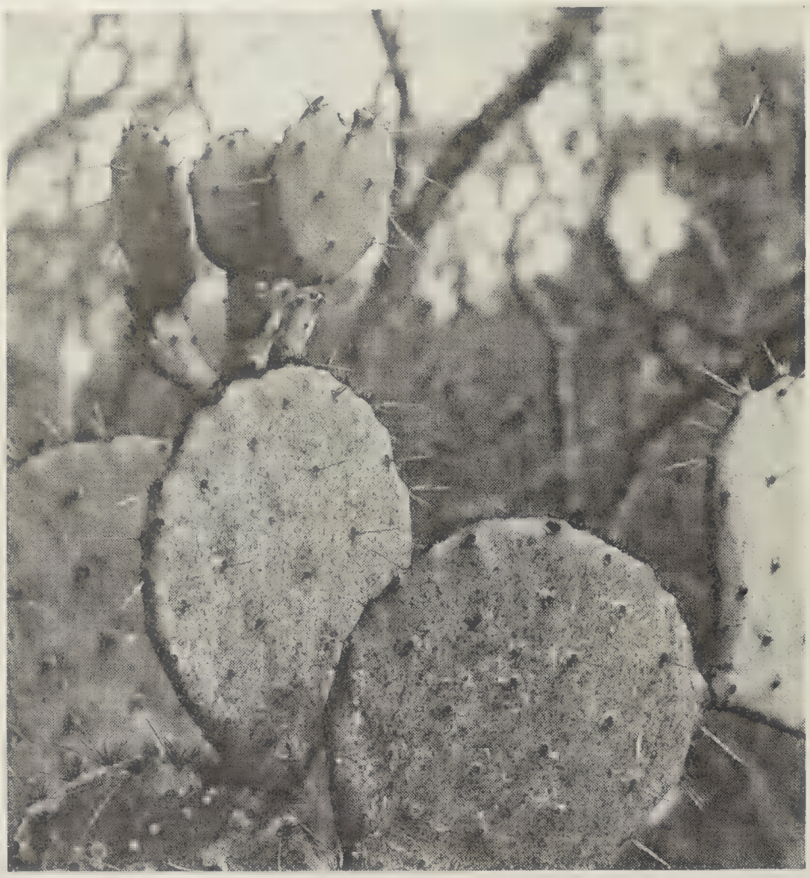
which in the latitude of Maryland devotes its entire development to leaves, the plant must be grown in greenhouses in winter during shorter days if it is to seed. Or, if it is to seed profusely, it must be planted and grown in Florida, where the summer day is shorter than that of Maryland. Shorter days herald the approach of winter, and tobacco is one of those plants which are adjusted to anticipate the change of seasons in this manner by the production of seed.

Dry, hot winds of a Central Plains summer, icy arctic blasts of a late frost, inundation from an overflow—each in its own way exacts a toll from the life it affects, each brings death to the individual. Yet, none of these forces can work the extermination of the species; for, as death stalks, new life is prepared and laid to rest in the shroud of its dead parent to await another spring. No wonder man, in his groping toward an understanding of the Universe, conceived of the immortality of the soul!

So, in this endless quest for life a feeble, bent broomweed blossoms with starry yellow flowers beside a burning hot roadside; the homely carrot of the garden rushes into bloom after a sudden late frost and dies with seed matured, instead of growing a healthy, tuberous root; a nearly drowned willow or aspen blooms once more as the slowly rising waters impounded behind a dam begin the tree's destruction.

Nor are plants the only victims of these natural tragedies; animal life responds to the extent of its ability. The caterpillar enters its pupal stage in advance of its normal time following an injury; the viviparous fly releases its maggots when trapped or hurt; the hen stops laying and starts incubating her eggs ahead of time with the arrival of hot weather. And this should not seem strange, for the human mother, without volition and through forces completely beyond her control, may enter labor and give premature birth to her child when fear, shock, or physical injury threatens her own life. It is the unconscious response to danger threatening the survival of the species. In one last valiant effort the body strains to thwart the grim reaper. Though dying, the body, whether human, animal, or plant, sets into the world a new spark of life with which the continuity of the kind may be maintained.

Then there is the example of the bee, whose communal life has become classic. Among the bees, with their perfect division of labor according to the individual's ability, the perpetuation of the kind is left entirely to the queen-mother. She weds with the drone, who, when his mission in life is done, is rewarded by death so that the food supply of the hive will not be needlessly expended. He is either cast out to die of starvation or mercifully stung to death by the workers. The queen-mother lays the eggs. The workers—all of which are sterile females and the old maids of the insect world—attend to the young, do all the necessary work, but never reproduce their kind. Indeed, reproduction on their part would be totally impossible.


If an insect lays its eggs in a prickly pear, growth is started anew and the new pads fall off and take root

In spite of the seeming fixedness of the potentialities of each member of the bee colony, the species still holds a trump card in its battle with death. Should death destroy the queen-mother, the species must play this card in order to survive. If no other queen is at hand, the egg destined to be a worker is placed in another cell and nourished to become a queen-mother. Should even this egg be unavailable, a sterile worker will in some mysterious manner become a fertile female, assume the role of the queen-mother, and carry on the continuity of its kind. The chain of life must remain unbroken in order to exist.

The strange and almost supernatural feature of this power to carry on reproduction is that it lies beyond the realm of voluntary control and almost beyond the powers of human comprehension. Ants, whose colonial habits rival and sometimes exceed those of the bee, likewise can under conditions threatening the extermination of the species produce a queen-mother to continue the creation of progeny. Those ant-like, wood-digesting insects known as termites are likewise so endowed. And the result is an enormous potentiality to live and a wonderful ability to beat death's effort to eliminate a species through the destruction of the individuals.

More commonplace are the unique relationships existing between organisms of different origin. The end-results of their mutual activities continue to stimulate the perpetuation of their own kind. Everyone has seen the warty, knot-like growths on the twigs and leaves of such trees as oak, hackberry, elm, and others. These galls are the consequence of the stimulus provided by an insect which stings the affected plant part to deposit its own eggs. The plant, to defeat self-destruction, develops corky tissues which in turn provide shelter for the larvae of the insect.

Among that large group of cacti known variously as prickly pear, nopal, or—in some of its forms—as cane cactus, the sting of an egg-depositing insect upon the seed-bearing part of the flower produces startling development. The particular insect associated with this cactus stings the ovary in which the seeds are to mature and deposits its eggs within the plant ovary. The

In bryophyllum, if the roots rot, each leaf produces new plants at the margin. These later fall off and take root. Thus the species lives on

cactus, whose own progeny are now endangered, is stimulated to renewed growth and promptly produces a new flower from the summit or the side of the old ovary. Should an insect again sting the new seed container, the cactus responds again in a similar manner.

The final result may be a chain of ovaries attached to each other, each representing the plant's involuntary effort to perpetuate its kind against the forces threatening its death. Dr. Rose, who before his death stood as the world's foremost authority on cacti, reported cactus plants in the southwestern deserts with chains of such proliferating ovaries several feet in length.

Thus each organism, in its own way, works against death and, because of that constant threat, provides in the most ingenious of ways to insure life for its children. The pathetic effort of an apricot tree whose life is doomed through frost injury to flower and fruit out of season in one valiant last effort to make seed is a drama in survival. The early maturity of the fruit of the virus-sick peach tree is a similar effort to beat death to the punch.

Likewise, the peculiar response of the so-called air-plant, *Bryophyllum*, whose leaves produce miniature plants upon its margin, is peculiarly adapted to survival. In its native tropics, when high humidity induces destructive rot to ruin the roots and stem of the plant and thus doom it to death, each leaf creates its share of small plants. These later fall to earth when soil conditions are again more favorable for growth.

Man, through his powers of reason and observation, has come to recognize how he may develop these peculiarities of plants and animals to his own ends. He has discovered that certain chemical substances known as hormones are really powerful poisons which in extreme dilutions stimulate dormant plant cells to develop roots where none would normally appear. So now he places cuttings of plants in hormone solutions and in an amazingly short time grows roots on even very obstreperous species.

Or man plays with the delicate germ plasm of certain animals and fungi under the odd and dangerous light of the X-ray and finds that evolution has been enormously hastened and even diverted into peculiar new channels. What will he get? A new species of interesting value? That depends upon the human interpretation and definition of a species. Scientific logic states that it is still the same old species, fighting a form of death by developing a mass of individuals, among which may be some more able than the rest to survive.

Thus all life owes a debt to death, for death stimulates powers within the living being to fight more effectively the forces which threaten its destruction.

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The Auto Show Moves In

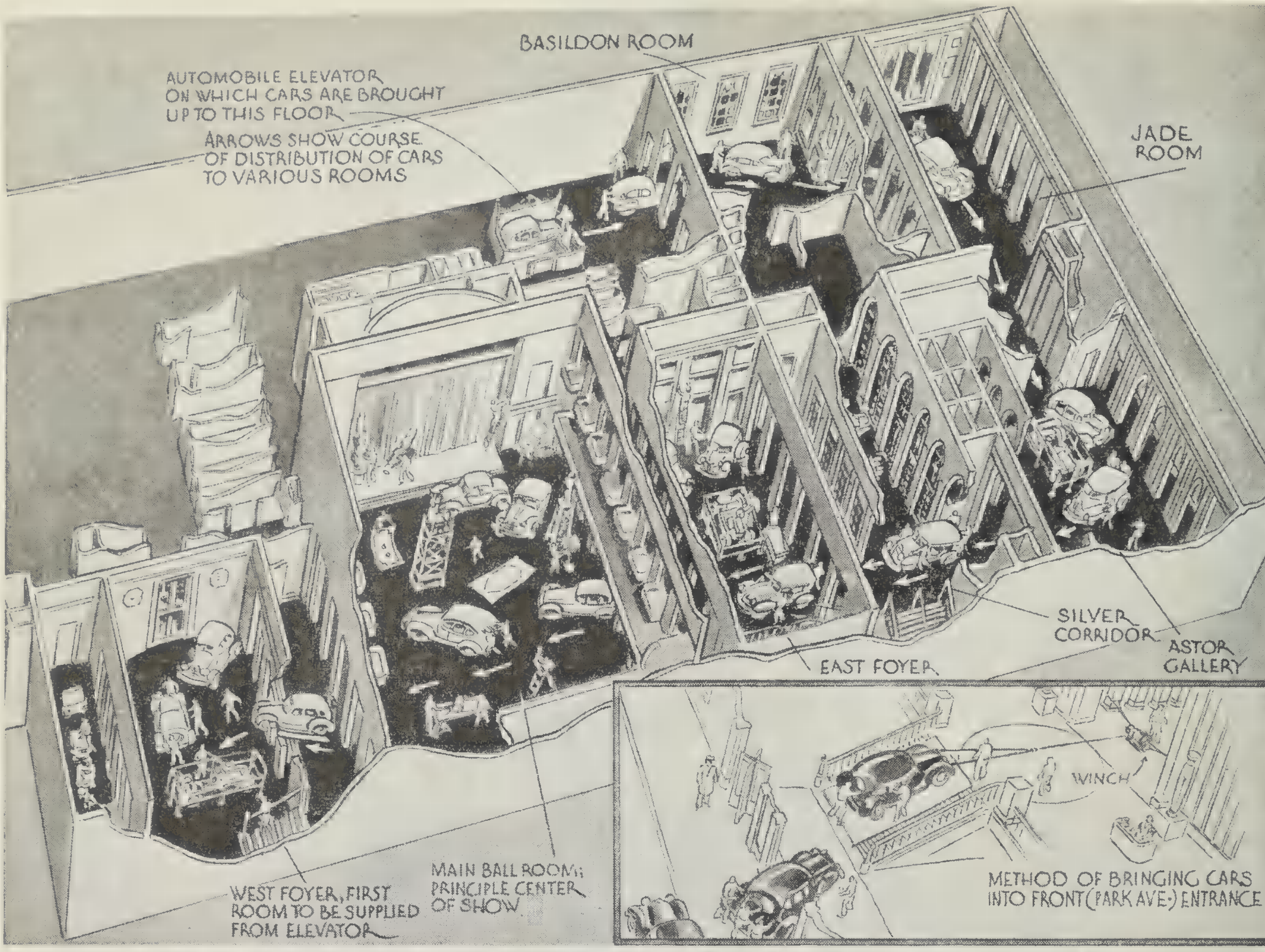
Mechanics of Handling the Cars and Other Displays in the Ballrooms of a Huge Hotel

H. T. RUTLEDGE

SURGING crowds surround the gleaming 1941 model motor cars in the main ballroom. In five adjoining salons are more cars, other mechanical displays of the automobile manufacturer's skill, more crowds. Yet only a relatively few hours before the first spectator looked upon this exhibit, these same rooms were devoted to the routine affairs of modern metropolitan hotel activity. So perfect is the setting for the motorcar show, however, that one might be almost willing to believe that the space so occupied was originally designed for just that purpose. And so it was, in the case of the Waldorf-Astoria Hotel in New York City where, a few days ago, was presented the annual General Motors display of their new models.

When the hotel was under construction, some 10 years ago, representatives of the motor-car manufacturer gave whole-hearted co-operation to the architects and builders. Even before the hotel was started, it had been decided that General Motors would hold its own annual display in the Waldorf-Astoria, in addition to participation in the Grand Central Palace Show. Knowing full well the headaches that accompany the presentation of an automobile display in buildings not designed for the purpose, officials of the manufacturing company were anxious to forestall future trouble.

As a result of this foresight, it is not only possible to make the best use of the available space for displaying cars, but also to bring in



Preparing for the auto show at the Waldorf. *Inset:* How lobby display cars are brought in

the cars and other equipment with a minimum of difficulty and a maximum of speed. Surrounding the Grand Ballroom at the Waldorf are five smaller salons—suitable for individual displays by General Motors car divisions. A template layout of the ballroom floor is made for each annual show, and the number of cars to go in each salon is decided. Of course, all of the car divisions want to have mechanized exhibits such as cutaway chassis and transmission displays in addition to the show cars, so it is necessary to subtract car space to make way for these animated attention-getters. However, the choice of display material is left, insofar as possible, to the individual car divisions.

Information on what is to be displayed must be available well in advance of show dates, because preparations must be made to provide adequate electrical connections for each exhibit. Every car on the floor has special interior lighting; some of the revolving chassis require 220 volt current; some displays use A.C.; others D.C., and so on. The practice has been established to furnish all of this essential information to the hotel engineers well in advance of the show so that when the show-date arrives the electrical connections are all in place and ready for use.

There is a very definite limit to the time alloted for the actual setup of the show. A special invitation preview is to be held at 4 o'clock on the afternoon of the day before the Auto Show opens to the public. As a margin of safety, the deadline for having the show shipshape is set for 12 noon.

By advance arrangement, the three small ballrooms nearest the freight elevator are cleared for action 56 hours before the deadline. Dozens of crates and boxes of all shapes and sizes, packed with panels, sections of wall, canopies, decorative fabrics, and numberless articles of ornamental and utilitarian nature are hurried into these rooms and unpacked. Time and space must be found to dispose of all of the crates and boxes, to say nothing of the task of putting together the many sections which, when assembled, make up the elaborate decorations.

Swarms of workmen, most of them old hands at the game, hustle the bulky panels and decorative pieces into a semblance of order so that the moment the Grand Ballroom is declared available the pieces can be fitted into the positions for which they were built. The entire ballroom floor is available for the decorators just 32 hours before deadline. Then the transformation begins.

Special equipment to facilitate the job has been provided by the Waldorf engineers. One unique tool is a miniature derrick which is used to hoist canopies of substantial size and weight into position over main entrances. Another is a tall, scaffold-like dolly for setting up huge panels which border the main ballroom.

Each piece of decorative panelling, when designed, has to be divided into pieces small enough to meet certain physical limitations, such as the length of the freight elevator, the sharp turns in the corridors, low doorways, and so on. They must be lashed, not nailed or screwed into position. No damage must be done to the walls or pillars of the ballroom.

Twelve hours before the deadline, the first cars and displays are brought up on the huge elevator. It would seem that the job should be simple—just put the cars on the

elevator and push them into place on the ballroom floor, but it is not quite that easy. There are six different makes of General Motors cars, in addition to displays by Frigidaire, Fisher Body, Research Laboratories, Delco Appliance, GMAC, GEIC, Customer Research, Diesel Engine, and others. Some require a lot of time to set up; some are practically ready for the show the moment they are in place; some are to be centered in rooms through which other cars and exhibits must pass in order to reach their proper position. Here is a job that calls for organization.

When Auto Show cars are shipped to New York, they are directed to the storage places of the various divisions which are in somewhat scattered locations around Manhattan. Cars addressed to the big show at the Grand Central Palace must not be confused with those consigned to the Waldorf show. The Waldorf cars, by direction of a GM Central Office co-ordinator, are each assigned a number. A large tag bearing the number is placed in plain view on the radiator grille or bumper.

At the hotel, the only route from the freight elevator to the Grand Ballroom that can be maneuvered by long-wheelbase cars is a roundabout passage through four of the parlors in which cars are to be displayed, a distance of between 400 and 500 feet. This means that car #1 must be the car consigned to the farthermost point from the elevator so that it can find free passage through the rooms without interference from other cars or displays being placed in position. Each succeeding car fills in the most distant spaces from the elevator until the last unit occupies a spot just a short distance from the elevator.

None of the cars may be driven —they must be trucked to the hotel. It is obvious that the truckers must be on their toes to get the low number cars delivered first. Chevrolets, Pontiacs, Oldsmobiles, Buicks, LaSalles, Cadillacs—all must be picked up at different storerooms and brought to the Waldorf so that no time is wasted in getting them on the elevator in proper numerical order in relation to the numbered floor plan. Also, large exhibits, such as chassis and cut-away motors, must be moved in simultaneously, so that their entrance dove-tails into the car movement at just the right time.

Then, too, there is the fact that it takes longer to set up a cut-away chassis than it does to place a car in position. Squarely in the center of the Buick salon may be the spot selected for such a chassis, and a start cannot be made on putting it up until every single car which is consigned to the rooms beyond has passed through. With this problem in mind, a "time-in and set-up schedule" is prepared. If it is found that six hours will be required to get the chassis functioning, particular care is taken to be sure that all of the cars scheduled to be displayed in rooms beyond the Buick salon are in place before 6 A. M., allowing a full six hours for the Buick men to finish their task by deadline.

Even getting the cars properly located involves more than meets the eye. Ramps are laid to make it possible for the cars to climb steps. Rubber-tired jacks are used to jockey the units into exact position, with space for traffic carefully calculated. Gas tanks are drained, batteries disconnected, spring shackles are wiped free of grease, oil is drained, and interior illumination is installed. There seems to be no end to the details.

Time, time, time . . . the deadline has come and that four-hour margin of safety was a good thing. There is still some work to be done on exhibit set-up and the cleaning has necessarily lagged behind while work is still going on. Finally, with one hour to spare, the last car is polished and the show is ready. There have been times, however, when, twenty minutes before 4 o'clock, the ballroom looked hopelessly in disorder, but somehow or other the work got done, just in the nick of time.

Over and above all of the ballroom activity is still another job which must be handled in the wee hours of the morning of show day. It has been the custom to display a Cadillac car in the main lobby of the hotel, at the head of the steps near the Park Avenue entrance. There is only one way to get it in; by removing a door and frame, pushing the car over the sidewalk and through the door, and then getting it up the full flight of steps. It's a tight squeeze through the door, and another tight squeeze to get the lengthy unit around the corner so that it is headed straight up the stairway. A capstan is anchored to two huge pillars across the foyer opposite the head of the stairs, which pulls the car neatly up the steps on planks. It has even been necessary, when Cadillac planned to build a wider car than production models of previous years, to build a crate, weeks before the show, corresponding exactly with the outside dimensions of the car, and move the crate into the lobby as a sure check that the car would fit.

The Waldorf show has become a tradition in General Motors. It is the high point of announcement time, and assumes great importance as a stimulus in giving the new models a good start. During the annual motor show week, Detroit literally moves to New York and takes over the town, and as far as that goes, the entire nation. Automobiles are the topic of conversation everywhere, and the already automobile - conscious American public digests a whole new chapter of the History of Automobile Progress.

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BATTERY

Storage Type For Flashlights

THE user of a flashlight is faced not only with the expense of frequent renewals but also with the occasional necessity for using batteries that are weak and give a poor light. The Ideal Commutator Dresser Company has wiped away both these disadvantages with one stroke in the development of a storage battery for flashlights.

This new battery takes the place of two 1½-inch, size D dry cells. Its upper section is made of DuPont's Lucite, as that material is impervious to battery acid. This transparent material enables the user to see whether distilled water may be needed at any time, this water being added by unscrewing the top cap and dropping the water in with a medicine dropper.

LONG-LIVED FUNGUS

STARVATION and other unfavorable conditions seem to make no difference in the life of at least one fungus—that which causes the stem rot of rice. The Department of Agriculture says, therefore, that it is not practicable to try to control this plant disease by rotation of crops.

A six-year test was carried out by the Department's experts by screening infested soil to prevent

Above: **The Solovox, a musical supplement to the piano, has a six-octave range and an indefinite variety of tone colors.** *Below:* **Solovox keyboard**

new infestation. After the six years elapsed, they found some of the sclerotia still in condition to renew activity and cause the disease whenever there was rice tissue on which the fungus could grow.

SOLOVOX

Fascinating Sound Effects With the Piano

A NEW electronic musical instrument—the Solovox, designed to be played with the piano—was introduced recently by Dr. Frank Black, music director of NBC on the Cities Service program. Both musicians and piano manufacturers believe that it will stimulate new interest in the tradition of music in the home and will have a stimulating effect on the piano industry.

According to Dr. Fritz Reiner, "Laurens Hammond's new instrument, the Solovox, is not only an outstanding technical contribution to the number of electrical instruments but also a musical one. Its endless possibilities for creating new and fascinating sound effects in combination with the piano, will kindle the imagination of every pianist. In fact, the Solovox may revitalize the present style of writing for the piano."

The Solovox is Mr. Hammond's third contribution to electronic music, its predecessors being the electric pipeless organ which was first introduced in 1935 and the Novachord, which made its first appearance in 1939. Like these instruments, the Solovox is entirely electrical in operation, but unlike them it has been designed not as a complete instrument in itself but rather as an adjunct to the piano and to be played simultaneously with it. The Solovox consists of a keyboard with 36 keys, about one half the size of piano keys, which is attached by thumb-screws just below the piano keyboard, and a slim tone cabinet containing the necessary electrical equipment which is mounted underneath a grand piano or set alongside an upright piano. The Solovox keyboard is attached to the right end of the piano so that the player can span both the Solovox and piano keyboards with his right hand. Thus he can augment the brilliant percussive tones of the piano with a tremendous variety of tone colors, some of which suggest the shrill quality of the piccolo, others of which suggest the singing tones of the violin and the piercing tones of the brasses. The Solovox is easy to play and can be picked up by even the self-made pianist in a few hours. The Solovox is an instrument whose market possibilities are, numerically speaking, 1000 times greater that the organ due to its comparatively inexpensive price under $200.

MULTITUDINOUS

Bacteria In Ocean Use More Oxygen Than Fish

OXYGEN in the ocean is probably used up more rapidly by bacteria and other micro-organisms than it is by all the fish and other visible animals ranging from tiny shrimp to giant octopuses, suggests Dr. Claude E. ZoBell of the Scripps Institution of Oceanography at La-Jolla, California.

Bacteria swarm in the depths in simply incredible numbers, Dr. ZoBell states. A quart of ocean water may contain anywhere from 100,000 to 10,000,000 bacteria, consuming oxygen at the rate of .001 of a cubic centimeter to more than one cubic centimeter per quart per year. This looks rather insignificant, says *Science Service*, in reporting Dr. ZoBell's discussion, but there are quite a number of quarts of water in the ocean, and the total becomes staggering.

Oxygen consumption becomes a

particularly acute problem at great depths, for the only way this life-gas can get down there is to diffuse slowly from the surface—with bacteria and other living things snatching greedily at it all the way down. This dearth of oxygen may be an important factor in the paucity of life in the great abysses.

GLARELESS

Student's Light Makes Use of Polaroid

Polaroid is now available for the first time in a popularly priced study lamp that promises to be the modern successor to the old-fashioned "gooseneck" lamp.

Advantages of glare-free light are many. Black type may actually

disappear from a white printed page under certain glare conditions. But even under the most severe glare condition, it was determined that the proper introduction of Polaroid sheeting in the light path dissipates the undesirable glare element and restores the print-to-paper contrast that is necessary for effortless seeing.

FOREST GAME

Many Game Birds Thrive In Forests

Approximately 66 percent of the food of all birds consists of insects. A large number of song birds are the principal consumers of insects. Many of these birds feed almost entirely upon this sort of food. Game birds also take a great many insects, the young chicks more than the older birds. This is of particular importance from the viewpoint of sportsmen.

A recent study made at Massachusetts State College shows that the alder-bottom forest floor pro-

duces the greatest number of insects and spiders which game will eat. The second most productive source of large insects, suitable for game food, is the white-pine-hardwood forest type. But the greatest total of insects, regardless of their usefulness as game food, was found on the forest floor of the hemlock-pine type.

There are many kinds of game which thrive in the forest, and the forest is always justified, from a sportsman's viewpoint, not only as cover for wild life but because of the beneficial effect it has on watersheds, and consequently the favorable influence upon fish life.

SCRATCHLESS

Synthetic Rubber Gasoline Nozzle

AUTOMOBILE owners who have had their cars scratched by the brass nozzles of filling station gasoline hoses will welcome adoption of a

Rubber protects the car finish

new nozzle made of Goodrich synthetic rubber. This nozzle, shown in the accompanying illustration, is the first such nozzle to be listed by the Underwriters' Laboratories, Inc., and is the product of several years of research.

NOT DAFFY

"Condition" Animals to Fear One-String Fences

A SINGLE string, hung between slender posts, may be enough to keep the cow of the future in her pasture if cows are psychologically conditioned. The conditioning would only mean punishing the animal with a mild electric shock

every time she went near the string. Even a cow soon learns to stay away from all strings after that.

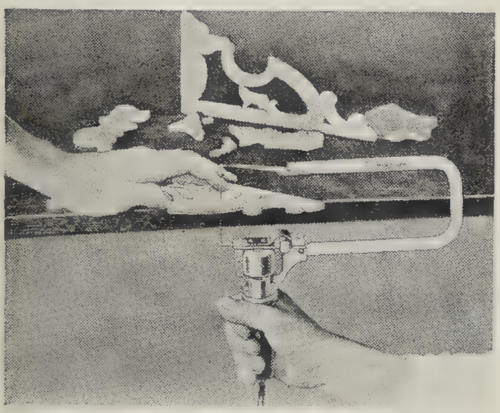
Psychology could thus save the farmer the enormous costs of iron fences and electric devices now used, Dr. A. I. Gates of Teachers College, Columbia University, recently told the Educational Section of the American Association for Applied Psychology. "Although a farmer neighbor of mine declared this was a daffy idea, it is good psychology," declared Dr. Gates.

—*Science Service.*

JIG-SAW

Hand-Operated, Inexpensive, Fast Cutting

A NEW jig-saw, put on the market by Dremel Manufacturing Company, is a hand tool which uses less electricity than a 75-watt lamp



Vibrating jig-saw

bulb, runs at a speed of 7200 strokes per minute, will cut through ordinary plywood at the rate of a foot forward per minute, and cuts so smoothly that no sanding is required. These details sum up the important features of the new Moto-Saw. The device weighs only 17 ounces, operates on 110-120 volt alternating current, and is priced at less than five dollars.

The illustration shows the ease with which this machine is handled. Above the hand grip is the vibrating mechanism which holds one end of the saw blade. The upper end of the blade is gripped at the end of a spring arm, mounted on a goose-neck frame.

ALWAYS BUSY?

Bees Take Life Easy When Food is Scarce

BY an ingenious device that relieves bees of their pollen loads while permitting free passage into and out of the hive, entomologists in California have compiled records that cast doubt on the familiar idea of the inveterate industry of these insects. When a bee is "as busy as a bee" she is that way because abundant food supplies are available for harvest. But when dearth occurs, she takes life easier and does not bring home much pollen, either for immediate use or to mix with honey for storage as bee bread.

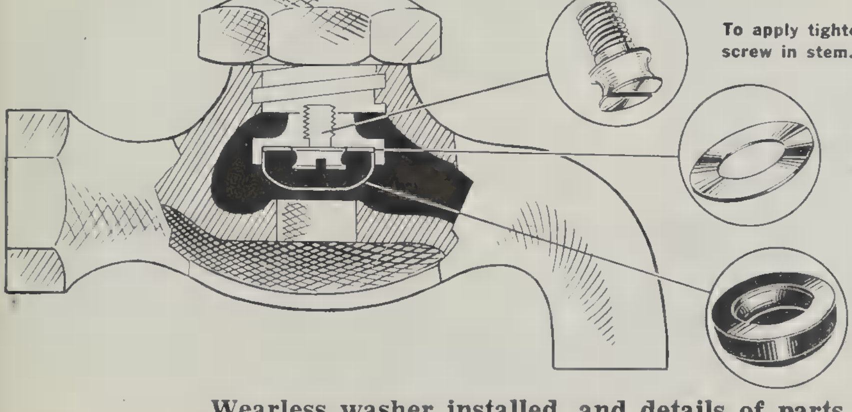
WEARLESS WASHER

A NEW snap-on washer eliminates leaky-faucet trouble. Made of rubber composition, it is so made that it does not turn and wear itself out against the seat. Furthermore, it is replaceable without a screw driver, as it simply snaps in place with the fingers.

This inexpensive new washer comes with a special screw having a grooved head, and a thin brass washer. The entire unit sells for ten cents retail, and replacement washers are but five cents.

In installing this device, the standard washer screw is removed and the grooved-headed one inserted tightly. Over this is first dropped the brass washer; then the rubber washer is snapped over the grooved head of the screw. The opening in the rubber washer is recessed so that a ridge moves freely in the groove of the screw-head.

When the faucet handle is turned, the entire unit revolves, but as soon



Wearless washer installed, and details of parts

as the rubber touches the seat it holds steady while there is slip between the thin brass washer and the rotating valve stem.

This ingenious new device is patented and is the product of No-Pans Washer Company.

WORLD CLOCK

Time Throughout World At a Glance

AT both the Golden Gate International Exposition and The New York World's Fair, the International Business Machines Corporation exhibited first models of a unique clock which may find use in airline depots, in steamship offices, and in many other locations where there is need for, or curiosity about, the time in all parts of the world. This clock, of comparatively large size, is to be mounted on the wall, and consists of a projected map of the world marked off vertically in hourly time divisions.

The map itself is immovable, but a black band lettered for hourly divisions of the day moves across the top of the map. Above this moving time strip is a spot in which minutes are indicated by numerals. Reference to the accompanying illustration will best indicate the simple method of reading the time for any part of the world. It will be noted that the time band has moved to a point showing that New York, for example, is in the 2:00 P. M. range. The 58 minutes indicated above the strip give the exact time in New York as 2:58 P. M. To the right, England and a large part of Europe are in the 7:00 P. M. range; hence the time in England is 7:58 P. M.

Similarly, the time in any other range throughout the world may be instantly read by looking upward from the geographical point to the time indicated on the time band and the number of elapsed minutes shown above that. One other point to note is that lights behind the map itself follow the movement of the band at exactly 12:00, Noon, so that one gets a sense of the sun spreading over that portion of the earth at that particular time and shading into dawn at the left and twilight at the right.

This clock is a development of Miss Maud M. Clough, and will be manufactured by International Business Machines Corporation.

BIBLICAL SCIENCE

Jeremiah Made Scientific Observation

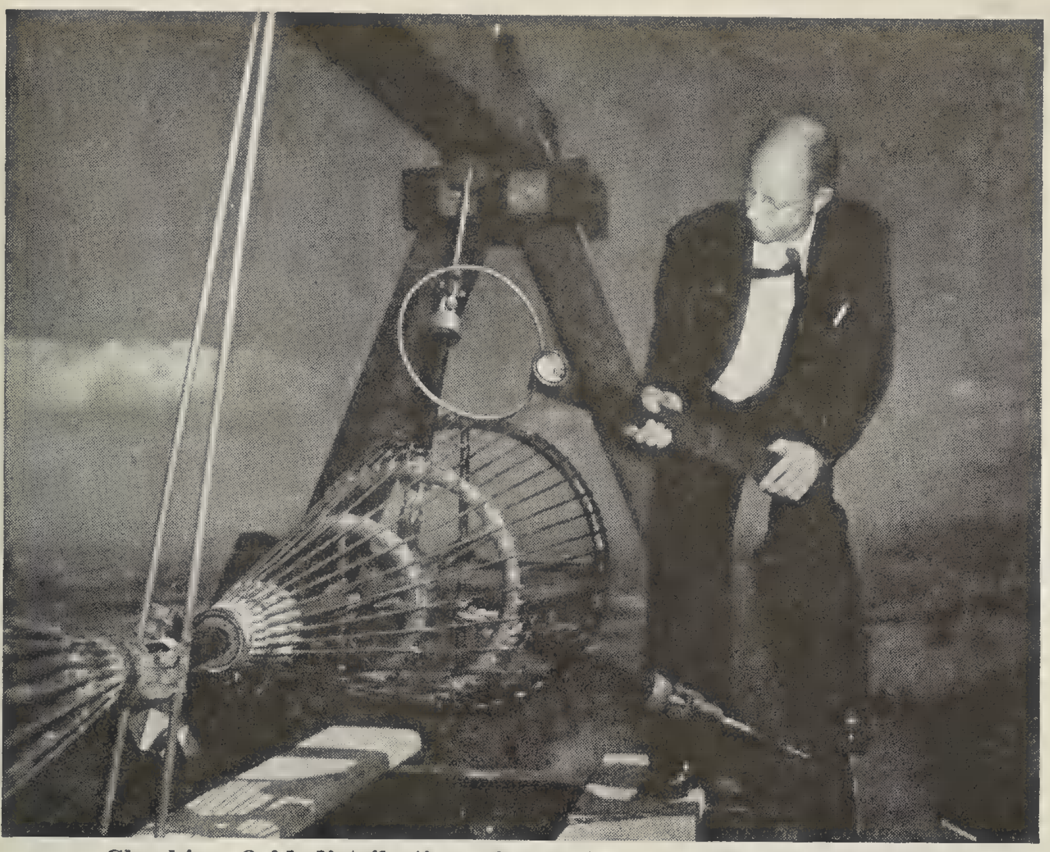
"YEA, the hind also calved in the field, and forsook it, because there was no grass.

"And the wild asses did stand in the high places, they snuffed up the wind like dragons; their eyes did fail, because there was no grass." —Jeremiah 14: 5 and 6.

Thus as long ago as biblical times the observation was made that when there is no grass on which animals may feed, one of the first and most characteristic symptoms is that of blindness. Today we know that grass and all green growing plants contain a yellow pigment, carotene, the precursor of Vitamin A, which, when absent from the ration of all animals, produces as one of its most specific symptoms, xerophthalmia, or blindness, prevalent in humans as night-blindness.

And even today, when scientists wish to determine the minimum vitamin A requirements of farm and domestic animals, no better technique is available than a deter-

Time to the minute, in any part of the world



Checking field distribution of new type of television antenna

mination of that minimum amount of vitamin A value which is just necessary to prevent the onset of night blindness.

Today the poultry- and cattleman can easily and quickly obtain a carotene assay of the feed he is to buy. Most feed manufacturers determine carotene as a routine practice in their laboratories and thus are able to protect themselves and their customers.

TELEVISION ANTENNA

With experimental work in television transmission progressing steadily and new methods being adopted in the endeavor to increase efficiency and service area, the accompanying illustration takes on added interest. It shows a part of the conical television antenna recently erected at the General Electric Company, Helderberg Station W2XB near Schenectady.

In the photograph, one of the engineers of this station is exploring the field distribution of the antenna, using the well-known closed loop and radio frequency meter set-up.

FOR CLOSE WORK

Lens and Lamps For Precision Work

If you have ever—and you probably have often—rigged up a strong light in connection with a large magnifying lens to do some close, fussy job, maybe you thought somebody ought to develop such a thing in finished, ideal form and manufacture it. This is what the Boyer - Campbell Company has done. It is a bracket with clamp to attach to a chair or other support; case containing lens and light. The one shown is for doctors and hospitals; a similar one for shop use or precision jobs has been developed.

Combination lens and lamp

MECHANICAL MEMO

Keeping memo sheets on a desk so they will always be handy yet not violate the executive's demand for neatness is a problem that has now

Turning the roller on this new memo case delivers one sheet

been solved by a new device—Rolodex, a "touch control" memo sheet case. Molded of Bakelite, it completely encloses over 200 sizeable sheets.

Near the front, on the top of the case, is a plastic roller. Underneath is the pack of loose memo sheets. When one is wanted, the fingers touch the top of the roller and, as they are drawn forward, the revolving roller brings out the desired sheet, right to your fingers.

SANITARY

Woven Plastic Seats Are Attractive, Clean

MORE and more, plastics are moving in on us—replacing products which, despite certain disadvantages, have been with us for generations. The latest move of this nature is into rapid transit vehicles to replace woven seat covers.

An accompanying illustration shows the seats in a New York subway car covered with Saran, a new woven plastic "fabric." Such seats, will be more sanitary and will not split and require replacement so often as do the present woven rattan splits.

Woven plastic seat covers are sanitary, clean, durable

END NUISANCE

Diathermy Apparatus Need Not Bother Radio

TRANSMISSIONS from electro-medical apparatus have actually been received across the continent and even across oceans. When diathermy interference first began to be serious a number of years ago, the disturbances were first attributed to stations operated by persons under the jurisdiction of foreign governments. Then the signals were traced to diathermy machines operated in medical centers and offices of private physicians.

Diathermy apparatus affects radio reception because the machines are essentially radio transmitters. The radiation that causes interference is not essential for therapeutic purposes and steps are being taken to prevent such radiation.

SYNTHETIC WOMAN?

The Chemist Can Clothe Her Cap a Pie

WE have long threatened to write someday an article on the synthetic woman—pardon us, the synthetic-clothed woman. Indeed, women are not only discovering that more and more of their garments and adornments are made of synthetics, but that these modern products of the

Celulose plastics add attractiveness to shoes, belt, bracelet

chemical laboratory are in some ways more attractive than would be the same articles made of natural products. We present, as an example, an accompanying photograph from Monsanto Chemical Company showing new accessories for evening wear. Attractive enough on the printed page, these articles, which are woven and crocheted in intricate designs, give the effect of simulating jewels. Furthermore, the material of which they are made is tough, strong, and resistant to water, so that only a damp cloth is needed for cleaning.

ANTI-AIRCRAFT

90-MM Gun, Now Standard, Is Effective Weapon

THE new 90-mm anti-aircraft gun is now a standard anti-aircraft weapon for the Coast Artillery. Its rôle will be essentially that of the present standard 3-inch anti-aircraft gun, M2A2, which it will replace insofar as future procurement is concerned. However, all serviceable 3-inch anti-aircraft guns, including those now under manufacture, still are classed as standard and are to be continued in service. For the present, technical details of the new weapon will remain in a restricted category.

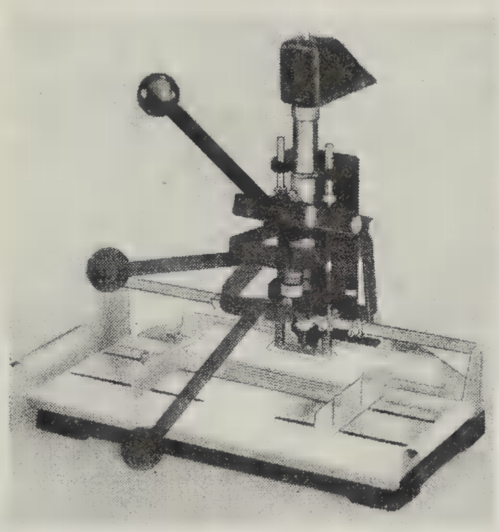
According to the *Coast Artillery Journal*, the gun will be known as the 90-mm anti-aircraft gun, M1, on 90-mm anti-aircraft mount, M1. Although its developed rate of fire probably will be slightly less than that of the 3-inch, its projectile is considerably heavier; hence in over-all effectiveness—number of effective fragments per unit of time—the 90-mm represents a considerable improvement over the standard 3-inch weapon. The projectile of the new gun also has a shorter time of flight than that of the 3-inch for corresponding ranges and consequently a greater maximum useful range. In over-all weight and in tactical mobility the two weapons are approximately equal.—*Army Ordnance.*

PAPER DRILL

Punches Many Sheets At One Stroke

IN collating all manner of office records, it is frequently necessary for an employee to use an ordinary paper punch, go through the complicated business of measuring a few sheets at a time, and then punching by hand the holes that are to fit the material into a binder. Even the larger, desk-type paper punches are often difficult to handle and do not punch accurately. Christie-Lucas, Inc., has solved all these problems, which can so often become major headaches, by developing a desk-type punch called the "Bull's Eye" paper drill.

This machine is actually a drill; it takes up to a one-inch stack of paper at one time, and will drill up to seven predetermined registered



holes without removing the paper from the tray. Despite this high efficiency, it is hand-operated and, therefore, may be moved to any location where it will find use for drilling manifests, sales bulletins, loose-leaf catalogs, and general correspondence.

Holes from ⅛-inch diameter up to and including 7/16 of an inch diameter can be drilled with this machine. Holes may be located from one-fourth of an inch to 1½ inches from the edge of a sheet. The leverage is six to one, and the manufacturer claims that any girl can operate it for hours with little fatigue.

CAMERA ANGLES

Conducted by JACOB DESCHIN, A. R. P. S.

Telling Stories With Your Movie Camera

THE motion picture camera is the story-teller par excellence in photography. The movie reel is the verbatim report of life's incidents, bringing to the screen as near an approximation of what we saw—and, in these days of amateur sound outfits, what we hear—as it is possible to achieve by means today available. The chief characteristic of the movies is motion. We take movies for that reason because it allows us to show a complete sequence of movements as when photographing a child at play or, by the stop-motion method, such subjects as flowering blossoms. But movement of itself is not sufficient. The movement must be significant, provide a living reproduction of something worth while, a subject in which movement is essential. Therefore, unless movement contributes to the objective of making the subject almost literally "come to life" on the screen, you may just as well take that particular subject with your still camera.

And that brings us to an inevitable comparison, odious though comparisons may be, between the results achieved with the still and the movie camera. Neither really competes with the other because each has its definite place. The still camera intends to and does catch but one instantaneous phase of a subject. Sometimes it makes as many as perhaps a dozen *separate* impressions of the subject and calls the group of pictures a story-telling sequence or series. Within the limits of the still camera it aims to accomplish what the movie camera does, but *without motion*. However fine the result, such a sequence or series can be nothing more than a group of individual stills or photographs of the same subject taken at intervals. The story may be complete within the limitations of the medium, but can never really be complete unless motion is introduced, to merge one still shot with another by the natural movements of the subject in changing from one position to the succeeding one.

The objective in all movie-making is the projection screen. In shooting film, particularly if economy is the watchword, as it should be, let us try

Figure 2

Figure 1

Figure 3

Figure 4

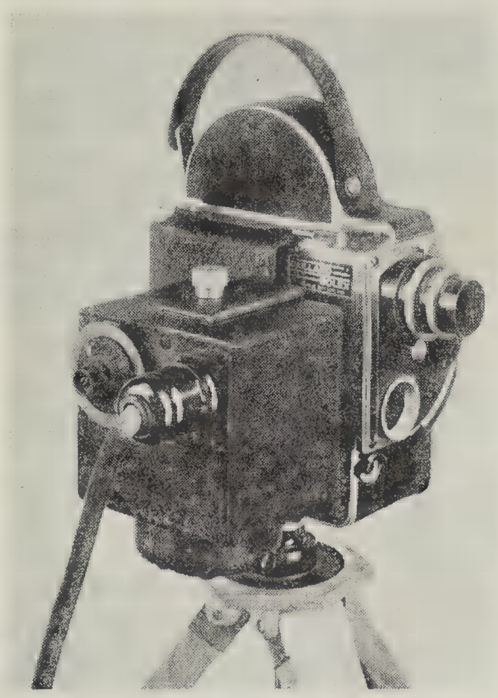
to visualize at the same time what the results will be when projected. Will our audience be bored because the scenes are too long or disappointed because the scenes are skimpy and therefore too brief to provide the impression or tell the story you thought you were shooting? Both faults should be avoided. In the first case, "splicing" in advance, that is, before shooting, is the best way, though some judgment and experience is admittedly required. The more splicing you do in avoiding insignificant and plus footage, the less you will have to do on the splicing block. On the other hand, if the scene is too brief it will be on and off the screen before your audience has had a chance to get any impression of it at all. Clipped scenes are probably the worst bugaboo of all for the still man who turns to movies for the first time. One of his first goals, therefore, though it is not too difficult to reach, is to battle and conquer the instinctive desire to short-change his scenes.

Concentration on significant movement is frequently accomplished by selecting an individual subject out of a group and shooting away at that until you have exhausted its possibilities. In Figure 1, we show a group of artist students painting a model on the beach at Provincetown. As a group, it was cinematically unworthy of more than brief notice—just long enough to show the group and allow the eye to get an impression of the general scene. But a look around will usually discover some one subject that holds promise of interesting movement. This we found in Figures 2 and 3. The young lady in question had grace, movement, and now and then struck attitudes somewhat flavored with humor.

The tiny fisherman made another good subject with the difficulties he was having keeping his fishing line untangled. A scene like this would make an attractive bit in a longer reel of other doings on the same wharf.

Sound Movies

DEVELOPMENTS in the sound-movie equipment first described in Scientific American for December, 1939, have brought it to a high state of perfection and flexibility. With available equipment you can make talking pictures at home, pictures as lifelike as those you see in the theater. You can photograph your family or friends, singing, dancing, performing dramatic sketches. You can take close-ups of dialogue. The voices will



Above: **Bolex camera with Synchrosound drive.** *Below:* **Turntable unit, five-minute disks**

Fifth Annual Scientific American

AMATEUR PHOTOGRAPHY CONTEST

OVER $1200 IN PRIZES

IN this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules. In addition to the seven major prizes and five honorable mentions, there will be three SPECIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners. *These special awards will be given in addition to the regular prizes that the pictures win.*

36 PRIZES *PLUS* Three Special Awards

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

Division 1. Human interest, including camera studies of people, animals, and so on. Portraits will be grouped in this division.

Division 2. Landscapes, including all scenic views, seascapes, and so on.

Division 3. Action, including all types of photographs in which action is the predominating feature.

IN **EACH** OF THESE DIVISIONS THERE WILL BE AWARDED SEVEN MAJOR PRIZES AND FIVE HONORABLE MENTIONS. WINNERS OF THESE PRIZES BECOME AUTOMATICALLY ELIGIBLE FOR THE THREE SPECIAL AWARDS.

RULES of the CONTEST

1. The groups will be judged independently on the basis of pictorial appeal and technical excellence. The decision of the judges will be final. In case of a tie for any prize, duplicate prizes will be awarded to the tying contestants.
2. Prints must not be smaller than 5 by 7 or larger than 11 by 14 inches. **All prints must be mounted**, otherwise they will be returned immediately.
3. Photographs must be packed properly to protect them during transportation.
4. Non-winning entries will be returned only if sufficient postage is included when the prints are submitted.
5. Each entry must have the following data written on the back of the mount: Name and address of contestant, type of camera, and film, enlarger, and paper used.
6. Contestants may submit no more than two prints in each group, but may enter any or all groups. In no case, however, will more than one award be given to any individual contestant.
7. Prints must be in black and white. Color photographs are not eligible.
8. Prize-winning photographs will become the property of Scientific American, to be used in any manner at the discretion of the publisher.
9. Scientific American reserves the right to purchase, at regular rates, any non-winning entry.
10. No entries will be considered from professional photographers.
11. All entries in this contest must be in the hands of the judges by December 2, 1940. Results will be announced in our issue dated February, 1941.
12. The contest is open to all residents of the Western Hemisphere who are not in the employ of Scientific American.
13. In fairness to all contestants, failure to comply with any of the above rules will result in automatic disqualification.

THE PRIZES

1st. Three $125 LONGINES, Coronation Model, Solid Gold, Men's Wrist Watches.

2nd. Three $85 LONGINES, Presentation Model, Solid Gold, Men's Wrist Watches.

3rd. Three FEDERAL No. 246 Photo Enlargers (List Price $49.50).

4th. Three FEDERAL No. 345 Photo Enlargers (List Price $42.50).

5th. Three PIERCE CHRONOGRAPH Men's Wrist Watches (List Price $19.75).

6th. Three BERMAN-MEYERS Flash Guns complete with case (List price $15).

7th. Three FINK-ROSELIEVE Vaporators (List price $12.50)

HONORABLE MENTION

1st. Three Fink-Roselieve "Hi-Spot" Hollywood type spotlights.

2nd. Three Mimosa Perkino developing tanks.

3rd. Three Raygram Wood-Chrome Tripods.

4th. Three Fink-Roselieve Audible Timers.

5th. Three Fink-Roselieve Satin-Chrome Range Finders.

THREE SPECIAL AWARDS!

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest. To the contestants who entered these three photographs will be presented the following special awards:

1st. One No. 715 Weston Exposure Meter (List price $24.)
2nd. One No. 650 Weston Exposure Meter (List price $19.95.)
3rd. One No. 850 Weston Exposure Meter (List price $15.50.)

THE JUDGES:

McClelland Barclay, artist
Ivan Dmitri, artist and photographer
T. J. Maloney, editor of U. S. Camera
Robert Yarnall Richie, photographer

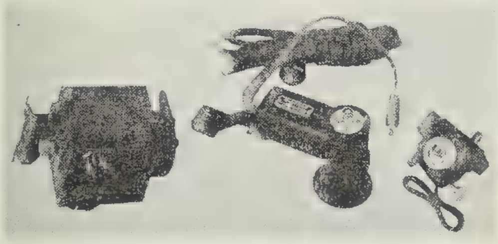
Address all Entries to

Photograph Contest Editor, Scientific American

24 West 40th Street New York, N. Y.

be perfectly synchronized with the lip motion.

You can add narrative comment, music and sound effects to your present library of silent films. Your voice and music will match the action of each scene with split-second accuracy. Talking pictures can be made on either 8mm or 16mm film, black and white or color. The film is run at



For sound movies: Camera drive, turntable, and projector units

silent speed, 16 frames per second, saving one third of the cost of sound-film productions.

In addition to their low cost, disk recordings have several advantages over film recordings for home, educational, and experimental uses. The sound reproduction from the disk recordings is equal to the best sound-on-film. Each sound recording can be played back immediately after it is recorded for checking purposes. The records can be edited to match the final edited film. With synchronized disk recordings you can add sound to colored pictures without printing. The original reversal film may be used.

These advances in home movie making are made possible by the Syncrosound System which enables you to combine home movies with home recordings. Synchronization between the disk and film is assured by a fool-proof mechanical and electrical locking system.

To make and project talking pictures, you will need, in addition to your camera and projector, a portable sound recorder and three Syncrosound units—one for the recorder, one for the camera, and the third for the projector. The turntable unit is equipped with a bracket and mounting post so that it can be mounted on any recorder, home phonograph, or record player by means of one screw. The camera drive unit is designed so that the tripod screw and one bracket hold the camera and motor drive firmly together.

Syncrosound units are now available for Ampro projectors, Bell & Howell 8mm and 16mm cameras and projectors, Bolex cameras, Keystone 8mm camera and projector, and the Victor 16mm camera and projector. Units can be supplied for other makes on special order.

Use the Large Stops

When making enlargements, it is generally preferable to use the larger stops. Some workers automatically stop all the way down as a matter of course, after having focused with the lens wide open. The only times it is really necessary to use the

smaller stops is when the film plane in a faulty enlarger is not quite parallel to that of the baseboard—in which case you should have something done about the matter anyway—and when projecting on a tilted easel as when correcting for distortion. At the very small stops, there is the danger of picking up the grain of a ground-glass diffuser, causing scattered light to cut down the contrast of the print, and unsharp pictures due to vibration during the relatively long exposures necessary at the small stops.

When is a Candid Shot?

PROBABLY you won't believe it, but this is *not* a posed picture in the usual sense of the term, although it surely does look like one. The gentleman was intently studying the picture possibilities in a group of fishing boats, when we came along and made our picture. This was a rather easy one because the subject was absorbed in thought.

"Camera Fan"

Lamp for Ultra-Speed

A STUNT of the laboratory has become the useful tool of the working photographer in Eastman Kodak Company's adaptation to general uses of the lamp employed for high-speed photography by Dr. Harold E. Edgerton and his associates of the Massachusetts Institute of Technology. The unit is known as the Kodatron Speedlamp and employs a gas-filled, electrically-operated flash tube, providing an effective flash speed of about 1/30,000 of a second. This speed has been found to be adequate to stop virtually any moving subject except a rifle bullet. Although the speed of the flash could be boosted to 1/1,000,000 of a second, light volume would be cut down correspondingly.

The single flash provides illumination equivalent to that of 40,000 50-watt tungsten lamps, sufficient to provide fully-timed negatives of an average subject 50 feet from the camera at a lens aperture of $f/11$. The

1/30,000th second speed is, of course, many times faster than the highest setting of any camera; about 800 times as swift as the wink of an eye, and about ten times as fast as is necessary to stop an athlete in action. The tube yields more than 5000 flashes, after which it is replaced with a new tube. One flash can be made every 10 seconds, the charging time of the condenser.

"The Kodatron flash is accomplished," write the manufacturers, "by discharging a condenser through a gas-filled tube. Ordinary 110-volt, 60-cycle current is led into the power unit of the lamp, where a specially-constructed transformer steps it up to 2000 volts. This current is then rectified and used to charge a condenser. When the trip circuit is closed (manually, by a flash synchronizer, or by the photocell unit), the energy stored in the condenser is discharged through the tube in approximately 1/30,000 of a second, producing a flash of high photographic efficiency."

Kodatron Speedlamp

The flash lamp itself has a tubular frosted glass shell, fitting over a spiral glass tube which contains a mixture of krypton and xenon gases. This is the flash element, the gas heating to incandescence when the condenser charge is released through it. Centered in the coil of the gas tube is the modeling or focusing light so that the angle of lighting is the same for both flash and modeling light. The modeling light is a V-filament projection type bulb of moderate wattage and long life.

Why Retouch?

A BRIEF for retouching as a matter of prime necessity, if successful portraiture is the goal, was recently put forth by J. Ghislain Lootens, F.R.P.S.

"If you are interested in portraiture you are going to retouch or be disliked by your friends," writes Mr. Lootens, who is a widely known teacher of photography as well as one

of our ace pictorialists. "Of course, if you're a professional you don't even expect to take portraits without some retouching—that is, if you intend to stay in business.

"Experience has taught that there is no system of lighting or type of film that will consistently give pleasing pictures of all sitters. We, therefore, don't retouch for the fun of it—it's a prime necessity.

"The average amateur buys a book or magazine illustrating the so-called secrets of lighting and faithfully measures the correct distance between his sitter and lights. He even uses the same equipment as the maestro, but his own pictures are simply terrible. Why? Unquestionably he has been trying to imitate a portrait that was beautifully retouched, but no mention was made of that fact.

"My advice would be: Study good portrait lighting, of course, but don't forget that retouching goes with it."

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THE ROUND TABLE

Questions Answered for the Amateur Photographer

Q. **I have heard that one can spot glossy prints by using graphite dust. How is this graphite mixed?—H. M. M.**

A. The graphite is simply shaved off an ordinary lead pencil, the regular spotting brush moistened and a little of the graphite picked up on the end of the brush, which is first formed with the fingers to a point. Slightly work the graphite into the point of the brush using a piece of paper as a palette and then apply to print a little at a time. It is best to apply retouching dope to the area to be spotted. A retouching pencil or spotting color on a brush may also be used.

Q. **Directors of photography for motion pictures carry the title A.S.C. Will you please tell me the meaning of the above letters?—H. H.**

A. These initials stand for American Society of Cinematographers and indicate membership in that society.

Q. **I have trouble with drying marks on my negatives. Can you offer a remedy?—D. G.**

A. Make up a solution of

Sodium carbonate	1 ounce
Water	10 ounces

Place the negative in the solution and warm the latter to 90 degrees, Fahrenheit. Cool the solution to 60 degrees and rinse the negative in water at 60 degrees. Now place the negative in a hardening bath, wash and dry.

Q. **Is there some convenient method of making enlargements without white borders?—D. L.**

A. Every worker who desires borderless prints has his own way of achieving this end. One way is to cut five-ply board with dimensions about an inch larger each way than the largest picture you intend to make; for example, 9 by 11 inches for 8 by 10 prints. Center the paper on this board; at each corner drive an insulating staple, allowing it to project just far enough to permit slipping the corner of the paper in and out. For focusing the image, the 8 by 10 area may be painted white or you can use a sheet of thin cardboard or paper cut to the exact dimensions of the paper to be printed.

Q. **Is there a remedy for bringing back to life negatives that have become dry and brittle?—S. C.**

A. There is available a formula for conditioning negatives that has given satisfactory results in many instances. Here it is:

Camphor	1 dram
Menthol	1 dram
Oil eucalyptus	2 drams
Glycerin	4 ounces

Q. **Will you please suggest a method for removing developer stain from negatives?—R. A. L.**

A. The negative is first bleached in the following solution:

Potassium permanganate	50 grains
Table salt	¼ ounce
Glacial acetic acid	1 ounce
Water to make	20 ounces

After bleaching, rinse the negative in plain water; then place in

Potassium metabisulphite	1 ounce
Water to make	20 ounces

Leave it in this bath until the image turns white, then redevelop the negative in any non-staining developer.

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WHAT'S NEW

In Photographic Equipment

GRAFLEX ANNIVERSARY ENLARGER ($87.50, including one negative carrier, but without lens): Condenser-type enlarger for negatives up to 2¼" by 3¼". Features "variography," altering of linear perspective by means of two-way tilt of negative, tilting lamphouse, and accessory universal-tilting easel holder. Tripod-type column furnishes two anchor points for arm carrying head. Rear leg of column serves as guide for counterweight and as conduit to keep waterproof lamp cord out of way. Baseboard 24 by 32 inches; leveling foot at right rear corner. Head supported near center of balance and counterbalanced by weight on other end of cable that runs over wheel at top of column. Negative triple-cooled by circulation of air, by radiation of heat from deep fins on lamphouse, by isolation from any direct metal path by which heat of lamp might reach it. Double condensers in basket-type carrier that bayonet-locks in position can be replaced by diffusing screen for soft light to lower contrast of print or conceal negative blemishes. Lensboard bracket accepts Miniature Speed Graphic lensboard. Negative carrier can be used with or without glass. Head comes off to mount

camera on arm for copying, macrophotography, or photomicrography; Graflex, Speed Graphic, Graflex Photorecord Microfilm Camera, or any other may be used, as well as movie cameras for tilting and other close-up work.

WATSON 5x7 PORTRAIT CAMERA ($29.50): Adjustable with reducing backs from 2¼ by 3¼ to 5 by 7. Features: Tilging, swinging lens board and front; vertical, horizontal swing back; rising front board, sliding front, all-metal slide. Reversible back. Full-length slide locks camera in normal position. Flexible 14-inch bellows.

SPEEDEX JUNIOR CAMERA ($11): Employs same design, styling and construction as original Speedex, with body shutter release; centrally-located optical eye-level finder; rapid opening, precision movement of front platform; and hinged back with safety latch. Fitted with fixed-focus, four-aperture, double lens of rectilinear correction, with shutter giving instantaneous and time exposures. Loads with B2 rollfilm, taking 12 pictures in 2¼ by 2¼-inch size.

PRINCETON MOLDED TENITE SUNSHADE AND FILTER HOLDERS ($1): Available in four sizes: Lens barrel—21-29mm, 31-39mm, 34-42mm, 37-45mm; Filter diameter—31.5mm, 39mm, 42mm. Size 34-42mm sunshade designed for Leica and Contax cameras. American made.

P. U. BROMOIL BLEACHER (25 cents): Package consists of two glass vials with Bakelite tops, holding 16 ounces of bleacher.

FOTH DERBY II ($31 with $f/3.5$ lens; $36 with $f/2.5$): Superimposed-image type, coupled range finder added to former model. Camera takes 16 pictures on standard VP roll. Shutter of focal plane type with speeds to 1/500 of a second, plus delayed action. Green and dark red windows for panchromatic and orthochromatic films.

ESSENKAY COLOR FILM ADAPTER ($4.50 to $6, depending on camera): Permits use of Bantam Kodachrome rolls in roll-film cameras taking Eastman 120 or Agfa B-2 film. Adapter installed or removed quickly. No special holes required. Made to couple with automatic film stop and film counting devices on cameras. At present available for following cameras (numerals designate number of exposures per roll of Bantam Kodachrome): Automatic Rolleiflex, 9; Super Ikonta B, 9; Rolleicord, 10; Argoflex, 8; Altiflex, 8; Wirginflex, 8; Korelle Reflex, 10; Ikoflex I, 8; Ikoflex II, 10.

MIRACLE SALON BROCHURE ($1 for 5 by 7; $1.50 for 8 by 10; $3 for 11 by 14): "Showplace" for prints. Contrasty white-enameled metal binding. Heavy celluloid cover for mounting favorite picture as cover of Brochure. Each print becomes full page of its own in book. Feature of book is method of mounting: brochure itself is series of narrow strips in binding, which operates on principle of first-aid bandage strips; you merely peel off glassine strip and expose adhesive-covered section. Then "finger-smooth" edge of print to strip. Prints may be removed at any time, without harm to print or Brochure, with provision for replacement. Suggested use: "double-mounting" prints, dry-mounting back to back to achieve effect of prints on facing pages. Complete with adhesive strips. Holds 15 regularly mounted prints, 20 to 30 back-to-back.

KODASLIDE COMPARTMENT FILE; KODAK MINIFILE BOX ($4.50 each): Kodaslide file box of black molded material, with matching hinged cover and latch. Inside are ten partitioned cells, each holding 20 Kodaslides. Minifile box, of matching design, size, and material, supplied with 25 transparent envelopes each accepting strip of four 35mm or Kodak Bantam negatives; 25 index cards, and 25 guides having visible tabs. Separator fits into notches at sides of case. Extra envelopes, 25 for 35 cents; extra index cards or guides, 25 for 25 cents.

HAMPDEN PANCHROMATIC MAKE-UP KIT ($1.50): For improving skin texture and facial modeling in photography. Kit contains five panchromatic shades of complexion foundation, varying in color from peach to chocolate, plus three shades of powder, panchromatic lip-rouge, eyebrow pencil, eyeshadow, lip brush, and powder puff. Foundation shades come in handy little wedge-shaped sticks. Illustrated booklet includes analyses of various facial types and solves individual feature problems.

WESTON MASTER CINE MODEL 720 EXPOSURE METER ($24): Styled along lines of Weston Master Universal, same size and shape, using same cell and instrument movement, but calibrated for motion picture camera use. Angle of acceptance for high scale 25 degrees. Extra scale for use in dim light. Manufacturer claims: "Model 720 will indicate a readable deflection in light levels so low that the correct exposure would be $f/1$ at 16 frames with a film having rating of 64 Weston." Top mark of 27 ample to handle brightest sand, snow and water scene.

"A TO Z" FIGURETTES ($1): For movie title backgrounds. Set includes 30 figurettes in brilliant colors. May be used over and over again; adhere instantly to wood, glass, metal or tracing paper. Applied without moistening. Photographs on black and white or color film. Cleaned with damp cloth.

AGFA TWIN-EIGHT PANCHROMATIC REVERSIBLE ($2 per 25-foot roll): For double-width 8mm motion picture cameras. Slightly slower than fast Twin-Eight Hypan Reversible, though similar in other characteristics, providing "high-quality panchromatic emulsion, brilliant gradation, fine grain, and high resolving power."

PHOTRIX UNIVERSAL PHOTOMETER MODEL B ($42.50): Equipped with instrument dial 3½ inches in width, reading 0 to 20 foot-candles in most sensitive range; intermediate range 10 to 100 fc; high range 50 to 2000 fc. Designed particularly for timing enlargements, required exposure time being determined by Photrix Enlargement Calculator, which can be inserted into lid of instrument case. Camera exposures can be timed with Photometer in conjunction with Photrix Exposure Calculator in all instances in which range or accuracy of pocket type meter is not sufficient. Other applications: densitometric measurements of negatives for timing contact prints, selecting printing papers, balancing three-color separation negatives.

YOUR FIREARMS and FISHING TACKLE

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; fishing tackle is a requisite of one of the world's oldest occupations. Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department which welcomes correspondence from readers.*

Mountaineers Test Marlin

WE'VE just subjected one of Marlin Firearms Company's new, redesigned Model 39-A lever action .22-caliber repeating rifles to about the toughest test we can conceive of. The Marlin 39-A, you know, is the only lever action repeating .22 in the world, and it's endowed with the same simplicity of breech action and construction that helped make John Marlin's name famous over 49 years ago. (See May, 1940 issue.) Latest refinements on this sweet shooting little gun include redesigned receiver, shortened tangs to permit remodeling of buttstock and to allow the comb to be moved farther forward. Coil main and trigger springs have replaced the flat steel type, producing smoother and easier working action.

We took this Marlin 39-A into the mountains of West Virginia, where the present generation of gunners are direct descendants of some of the straightest shooting rifle shots this country ever knew. Many things in the Mountain State have changed since the time of the great-great-granddaddies of today's shooters, but the West Virginian's demands on a rifle, small caliber or large, are just

Marlin 39-A

as stringent now as they were when accuracy and speed of operation meant preservation of life. The gun must feel right, sight quickly and truly, shoot straight and hard, and if you think the present day mountaineer doesn't recognize "oomph" in a rifle when he sees it, you're sadly mistaken.

When the boys in the Mountain State try out a new rifle, they don't bother with such prosaic things as Army L targets or any other kind. They, like their fore-fathers, are in the habit of shooting wild turkeys in the head, and that, gentlemen, is a real mark at which to shoot. Nor do West Virginia mountaineers use a vise of any nature to hold the gun steady for a target test. If you can hold an old 9-pound muzzle loader on a wild turkey's head long enough to put a lead ball 7/16 of an inch in diameter through said head, you don't need a vise.

No, they do it this way. They cut a piece of white paper about two

Mitchell and "Ol' Yella Jacket"

inches square and peg it with four whittled pegs to a block of stove wood, which preferably has been darkened by weather. They pace off 60 yards and lay a log on the ground at right angles to the course of fire. Stretched prone behind the log, they rest the front of the gun barrel on the log, but—and this is important—they do not support the fore-end of the gun with the left hand as we "civilized" target shooters do. They bring the left hand back so it can grasp the bottom corner of the buttstock where it projects slightly below the shoulder. The right hand takes the normal trigger position, but the left steadies the gun and prevents canting to left or right.

The results? Three West Virginians, none of whom had ever seen this Marlin before, each fired five shots (.22 long-rifle cartridges) at the target from the prone position. Of the total of 15 shots, 9 were well within the square of paper, two clipped the edges and the remaining four were in the wooden block, just off the paper's edge. The performance was repeated by three more shooters at the same range and this time only two shots missed the paper. The verdict? That portion of West Virginia's male population which did the shooting, as well as the onlookers, ungrudgingly and enthusiastically

voted this new Model 39-A Marlin to be one of the best shooting rifles it had ever seen.

Said Hugh Mitchell, one of the best of the marksmen, and a man to be feared in any shooting competition, "'Deed, Ah reckon this little gun is about the nicest shootin' rifle I've handled since my granddaddy gave me Ol' Yella Jacket." And by way of explanation, "Ol' Yella Jacket" is a 9½ pound muzzle loader with a 40-inch octagonal barrel 3 1/16 inches in circumference, a bore of 7/16 inches, and it still shoots a lead ball straight enough to take that wild turkey's head right off from the top of his neck. During the past three generations Mitchell's "Ol' Yella Jacket" has won more shooting matches than any other rifle, antique or modern, in that section of West Virginia's mountains, so praise from Mitchell is real praise.

Outboards for Ducks

UNDER provisions of the Federal Migratory Bird Treaty Act, ducks and other migratory game birds may not be hunted from a power boat, and a boat to which an outboard motor is attached is unequivocally within that category. However, like the lad in the picture, the hunter may use his Evinrude or Elto to propel his boat to hunting location; then he shoots from

Ducks . . . and outboards

the boat *after* the motor has been detached and placed inside the craft. Obviously, he may re-attach the motor, after hunting is over, to return home. Just to be sure on this point, we asked the Fish and Wildlife Service, Department of the Interior, and have their word that the above is the correct interpretation, but by all means take that motor off the stern before you start pulling triggers, or you'll be in trouble with Uncle Sam.

Strange Guns in Strange Places

IN 1842, Henry Deringer, Jr., manufacturer of famous pocket pistols that bore his name, received one of the contracts to furnish the United States Army with its first percussion pistols. In Brandon, Vermont, 29 years earlier, and in Hartford County, Maryland, three years earlier, were born two men, both of whom were destined to own famous Deringers and to bitterly oppose Abraham Lincoln.

The man from Vermont was Stephen Arnold Douglas, who ran against Lincoln in the Presidential election of 1860, and who later gave the martyred Chief Executive unfaltering support. The Deringer owned by Douglas had an engraved lock and hammer, with the word "Philadelphia" stamped on the former. On the German silver name plate, which also served as butt-strap, was engraved "S. A. Douglas." Before Stephen Douglas died in 1861, he presented his pistol to J. M. Tenny, then proprietor of the National Hotel, in Washington.

On the 14th of April, 1865, the man from Hartford County, Maryland, carrying a Deringer identical in every way to the one formerly owned by Douglas, save for the engraving of his name, slipped into a box in Ford's Theatre, in Washington, and shot President Abraham Lincoln. That man was John Wilkes Booth. It's a strange coincidence that Booth should use a facsimile of the pistol which belonged to Douglas, Lincoln's opponent for the Presidency. If you drop into the office of Francis Bannerman Sons, New York City, to whom we are indebted for this tale, and ask to see their extensive firearms collection, or if you'll browse through their annual "Military Goods Catalogue," you'll find many examples of "strange guns in strange places." Have you a story about "strange guns?" We'd like to hear it.

Hoffman Arms

IN tune with the growing demand from shooters for high quality, custom-built guns at moderate prices, The Hoffman Arms Company, a sterling name in the firearms world some years ago, has been fully and capably reorganized at its new plant in Amarillo, Texas, and is actively engaged in producing rifles and shotguns to

Captain Charles Askins, Jr., and his Hoffman .30-'06 sporter

the customer's measurements. After three years of careful preparation, including acquisition of a factory, selection of skilled artisans, purchase of gun-maker's steel, barrel stock, Circassian walnut, and a vast complement of tools and machinery, James A. Hedgecoke, millionaire cattleman, sportsman and sole owner, and B. R. Polley, general manager and one of the ablest of gun builders, announce they are prepared to serve America's discriminating gunners.

The Hoffman Arms Company is a complete manufacturing plant, not a mere assembly shop, and every rifle and shotgun will be entirely custom-turned from front sight to buttstock in rifle calibers from .22 to .50, and in side-by-side, double barrel, English type field scatterguns of 12 and 28 gage and .410 bore. Delivery is guaranteed in two weeks on .22 long rifle, .220 Swift, .250 Savage, 6.5 and 7 mm., .276 Dubiel, 30'06-300 Magnum, .375 and .404 Magnum, and on the above named types of shotguns. Six weeks are required for production of other calibers. In short, here is the American shooter's long-awaited chance to own that much desired custom-built gun at a moderate price, for Messrs. Hedgecoke and Polley announce their prices will be "tens of dollars beneath the usual cost of guns of this high quality." We'll be pleased to send along further details of The Hoffman Arms Company prospectus; it is mighty absorbing.

Gun Book of the Year

All too seldom in these days of mass publication there appears a book which causes one to gasp in amazement at the author's comprehensive treatment of the subject, to exclaim in admiration at the beauty of compilation, illustrations, and binding, and to marvel at the thoroughness and simplicity of presentation. Such a volume is "A History of the Colt Revolver," by Charles T. Haven and Frank A. Belden, who spent years in research, planning, and consultation with other eminent arms collectors and experts in preparing their work. It is a magnificent publication of over 700 pages, 8 by 11 inches, containing 500 illustrations.

In four parts, devoted respectively to history, from earliest known guns to modern Colts; an outline of the antique and obsolete models of Colt arms and their several variations; photostatic reproduction of documents contemporaneous to manufacture of Colt arms from 1832 to 1940; and facsimiles of a number of patents on the Colt revolver, the book not only is completely indexed, with a glossary, but also is arranged with Table of Contents showing chronologically the development of the revolver. "A History of the Colt Revolver" will prove to be an encyclopedia for the arms collector, an invaluable correlative volume for the historian, and a source of endless enjoyment and information for the layman.

Last month we mentioned our compilations of books reviewed during the past year. There are four of these lists, covering publications in the fields of firearms, fishing tackle, gun collecting, and natural history, and the only cost is a 3-cent stamp for return postage.

Insurance for Fishing Tackle

Comes now the time when anglers in northern zones, wistfully, with poignant memories, store away their tackle for the winter. The more care given to rods, reels, lines, lures, and boots when the frost is on the pumpkin, the better condition the gear will be in when ice goes out next spring and the first timid buds and hardy arbutus issue their annual siren call to hibernating fishermen. Hang boots heels up in a dry, cool place. Check rods carefully for loose ferrules, worn guides, cracked agates, and the protective coat of varnish. If the big-one-that-got-away left you a cracked or broken section as a souvenir, send the rod to the factory that made it.

To those who know how, removal of guides, windings, and worn varnish preparatory to application of the new coat and new wrappings is not a difficult fireside chore for winter evenings. In fact, it's fun and a good time to dream of new conquests, but if you've never done it, and if your's is a prized rod, it's best to trust the folks who made it. Too much varnish and poorly applied windings may completely alter the rod's action. Avoid excessive moisture or heat in storing rods and never leave them standing in the corner. They'll come out parabolically inclined. Store either in their aluminum cases or hung up whole or in sections perpendicularly on the wall by tip and by guide.

Reverse silk lines on the reels and thoroughly clean the reels themselves, and it's good insurance to alter the position of the click so a new point of the triangle will receive next season's wear. Enameled trout lines keep best off the reel, coiled and hung in large loops, preferably with support at many points, such as a 10-inch tube of blotting paper. Dry leaders, wash out leader boxes and moistening pads. As to trout flies, bass bugs, and other lures containing delectable tid-bits relished by moths, protect them in their cases or boxes with particles of moth balls or other repellents.

Winter is a good time to clean out the tackle box, sharpen up hooks on bass plugs, put a drop of oil on shiny spoons to keep them that way, and generally to take inventory to see what is needed. Christmas is coming, you know, and so are 1941 catalogs from Messrs. DeWitt, Heddon, Pflueger, Mills, Shakespeare, South Bend, Weber, and others. They'll be chock-full of splendid gift suggestions for the men of the house, and for milady Walton, too, especially if properly marked with a large, red pencil.

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for.

BRITISH WARSHIPS, THE ROYAL NAVY

By The Illustrated London News

PICTURES, text, and data concerning all the ships of the Royal Navy. Some of the illustrations, particularly of the larger ships, are full-page size; while there are also a number of cutaway drawings showing interior arrangement of ships—supply rooms, service quarters, and the like. Drawings also show armor protection of a number of the battleships. All data are extremely complete. (40 pages, 19 by 12½ inches, stiff paper binding, cover printed in gold and blue.)—$1.25 postpaid.—*F. D. M.*

LIFE ON OTHER WORLDS

By H. Spencer Jones

AT last a professional astronomer has written a whole volume on this most intriguing of all subjects connected with astronomy. And he has written neither as a radical nor as an ultra-conservative. That is, while the author's conclusions will scarcely feed the panting sensationalist with the "hop" he craves, he does not show any desire to play down the big question. What he does is to treat it just as the evidence of astronomical science appears to call for at present. The question is discussed for each planet. Readers will like the 17 illustrations—not of imaginary Martians but photographs of star clouds, nebular, lunar close-ups, spectra of planets, Mars and clouds on Mars, Saturn, Venus—all large and attractively produced. (299 pages, 5 by 8 inches, 17 plates.)—$3.10 postpaid.—*A. G. I.*

THE STEEL SQUARE

By Gilbert Townsend

HOW to use its scales, lay out braces, rafters and roof framing in general, and do other work. Written by a Montreal architect. (96 pages, 5½ by 8¼ inches, 102 illustrations.)—$1.35 postpaid.—*A. G. I.*

AIRPOWER

By Major A. L. Williams

MAJOR WILLIAMS has had a brilliant career as a naval aviator in the World War, with many flight records and other exploits to his credit. For many years he has been a close and brilliant student of military aviation and has written widely on this subject. His 1938 European tour (in his own single-seater) gave him a fine opportunity of studying at first hand the air equipment and strategy of both Germany and Italy. In "Airpower" he presents a graphic picture of such milestones in aerial warfare as the campaigns in Ethiopia, Spain, Poland, and Western Europe. His review of these campaigns and his views on the use of aircraft in modern warfare are of the greatest value and are most timely when the United States is faced with vital problems of national defense. We can almost forgive this splendid technician his hostility to England, his mistaken isolationism, because he brings us such a fine understanding of the problems of airpower and national defense.—$3.60 postpaid.—*A. K.*

GRAPHIC PRESENTATION

By Willard C. Brinton

AN excellent guide for all those inested in depicting statistics, flow of materials in production, flow of traffic along highways, progress, chronological, dot and pin maps, pictorial charts, multiple bar and contrasting bar charts, sector or "pie" charts, and numerous other modern "pictographs." A statement quoted in the book from Henry D. Hubbard of the National Bureau of Standards well describes the use of these various types of charts: "There is a magic in graphs. The profile of a curve reveals in a flash a whole situation—the life history of an epidemic, a panic, or an era of prosperity." (512 pages, 6¼ by 9¼ inches, leatherette cover, hundreds of illustrations.)—$5.10 postpaid—*F. D. M.*

A HISTORY OF THE COLT REVOLVER

By Charles T. Haven and Frank A. Belden

FOR over 100 years this nation has owed a debt of gratitude to Colonel Samuel Colt for his invention of the first practical firearms with combined automatic revolving and loading of cylinder. Without that device, settlement and control of the West, the successful termination of the Seminole Indian trouble and other episodes in later American history might not have terminated so satisfactorily. Today, that debt has expanded to include the authors of this comprehensive, factual publication and Colt's

THE DETECTION & IDENTIFICATION OF WAR GASES. A very complete title book on war gases, their physical properties, chemical reactions and tests, subjective tests, objective tests and identification. **$1.60**

TEXTILE TESTING—*By John H. Skinkle.* This book which is suitable as a text or reference work, gives several methods for any particular test, including rapid and convenient approximations. **$3.10**

FLORAL MORPHOLOGY—*By E. R. Saunders.* With special reference to the interpretation of the Gynaceum Vol. II. **$4.35**
Volume I—Published in 1937. **$1.60**

GARDENING WITHOUT SOIL—*A. H. Phillips.* A comprehensive collection of all that is at present known on the subject. **$2.10**

ELECTROCHEMISTRY AND ELECTROCHEMICAL ANALYSIS—*By H. J. Sand.* Volume I Electrochemical Theory—Deals with the theoretical side of the subject. Considered the best summary of the present position of the Ionic Theory. **$2.10**

Volume II Gravimetric Electrolytic Analysis and Electrolytic Marsh Tests—Deals with gravimetric analysis both on the ordinary and on the micro scale, and with the electrolytic Marsh tests. **$2.10**

SOAP MANUFACTURE — The Chemical Processes—*By J. H. Wigner.* Provides information of a practical kind for the use of those engaged in the manufacture of hard soap. **$4.10**

SULPHATED OILS & ALLIED PRODUCTS—*By Donald Burton & G. F. Robertson.* This book is complete with references; the analytical procedures are very definite, leading to standardization of method. The chemistry of sulphation is up-to-the-minute. **$5.10**

RUBBER LATEX—*By H. P. Stevens and W. H. Stevens.* A practical and useful book containing such recent information as chemically modified rubbers from latex, botanical significance of latex, microscopic descriptions and illustrations, etc. **$2.10**

CHEMICAL INDUSTRIES — A reference work to essential chemical facts and data. Containing in twelve sections matter which could not be found elsewhere in one volume, it saves lengthy search through files, textbooks, etc. **$4.10**

MODERN COSMETICOLOGY—*By Ralph G. Harry.* This is the first reference book dealing not only with modern chemical emulsifying agents including proprietaries, but also with medical questions such as the action of vitamins and hormones and any dangers arising from their use. **$5.10**

The above prices are postpaid in the United States. Add, on foreign orders, 25c for postage on each book.

EMBALMING FLUIDS—*By Simon Mendelsohn.* From the standpoint of the chemical aspects of the scientific art of preserving human remains. **$4.10**

FRUIT PECTINS—*By C. L. Hinton.* Their Chemical behavior and jellying properties. **$1.85**

BOILER FEED WATER TREATMENT—*F. J. Mathews.* Particularly beneficial to small plant operators who do not have sufficient financial resources to refer their problem to a boiler water chemist. **$5.10**

NEW Technical BOOKS in MANY FIELDS

INDUCTION MOTORS—*S. Gordon Monk.* The fundamental principles, properties and applications of induction motors. Well illustrated with drawings, diagrams, photographs. **$2.10**

COLE'S PERMANENT WAY—*Col. Sir Gordon Hearn.* Material, maintenance points, and crossings. Deals with all gauges and gives examples of practice almost all over the world. **$4.35**

FOOD INDUSTRIES MANUAL—*Compiled by Well Known Authorities.* A technical and commercial compendium on the manufacture, preserving, packing and storing of all food products. **$4.10**

HOME GARDENING ENCYCLOPEDIA—*Walter Brett.* Packed with 450 pages of information for the home gardener whose garden is made and looked after without professional help. **$2.50**

DICTIONARY OF METALS AND THEIR ALLOYS—*F. J. Camm.* Includes information about every known metal and almost every type of commercial metallic alloy. **$3.10**

DIE-CASTINGS—*Arthur Street.* A manual for the user, buyer and designer. Fully illustrated and with an extensive bibliography. **$1.85**

ELECTROCAPILLARITY — *J. A. V. Butler.* The chemistry and physics of electrodes and other charged surfaces. Deals with potential differences at electrified interfaces, the origin and nature of the effects that arise therefrom, and with electrode equilibria and kinetics. **$5.10**

THE CYCLOTRON — *W. B. Mann.* Includes a general description of the fundamental principles of magnetic resonance acceleration, and in more detail, a description of the cyclotron itself. **$1.60**

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By Edward G. Huey

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GUNS ON THE FRONTIER

By William MacLeod Raine

When, in Chapter Three, the author wrote, "All frontier communities have had to discover that law is not a lot of words written in a book," he succinctly described this work. The story of the struggle for law and order in early western settlements is graphically, authentically, and most entertainingly told. All the noted "bad men" are delineated with a clarity, vividness, and understanding of their quirks of character which would almost seem to tag the author as an eye witness. It is, however, his long residence in the Southwest, coupled with intense research for his numerous other books on frontier life which have been combined to portray skilfully this new picture of the bad man who lived his short, violent day before organized law was finally achieved. (282 pages, 5½ by 8 inches, 11 illustrations, index of characters)—$3.10 postpaid.—*A. D. R., IV.*

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

As the telescope making hobby continues to spread, the tendency to want permanent housings for the telescope increases; they save a lot of bother, and greatly add to comfort in cool weather. W. L. Moore, Coral Ridge, Ky., is the maker of the one shown in Figure 1. The lower struc-

Figure 1: **Moore's observatory**

ture serves as a tool house. The dome above it is itself 10′ in diameter and 8′ high. Its upper or hemispherical part is made of 28-gage sheet metal, with ribs similar to those suggested by Scanlon in "Amateur Telescope Making—Advanced." The vertical or skirt part is made of corrugated metal. Contrary to first appearances, however, the two parts are permanently attached to each other, an arrangement which affords a little more headroom at the sides. This puts the rollers, which are ball bearings from junked cars, down at the level of the observing floor. Moore says he can push the whole dome around with one hand. Inside, at present, is an 8″ reflector.

Chief value of studying others' work, before undertaking one's own, lies in finding what mistakes others made and not repeating them. Asked, therefore, what, if anything, he would not do again, Moore stated that he placed his stone pier, 30″ square, in the center of the dome, not realizing that if he ever wants to use a German or a fork mounting it will then be off-center. "If I built again," he points out, "I'd also make the seams in the dome a little higher. I turned up 1″ on one side and ½″ on the other but I should have made these 1½″ and 1″, respectively; so I had some trouble with leaks, having to use a lot of solder at the low places. I also made the frame of my shutter, which carries its two pieces of 36″ sheet metal, too light and it rubs on the dome frame, making it a bit hard to open the shutter. This wooden shutter frame rides on barn-door rollers."

A fat collection of "Things I'd Never do *That* Way Again" would be a big practical help in amateur telescope making. Who is there who couldn't contribute a few! Open invitation.

From Clayton F. Howe, 514 Arthur Ave., Kalamazoo, Mich., comes this note: "Here are photographs and a sketch (Figures 2, 3, and 4) of a turret eyepiece holder I have recently finished for use with my telescope. Holding a battery of three eyepieces of differing focal lengths, it is the most useful piece of equipment I have, next to my finder.

"The turret, made of aluminum, floats around on a thin film of oil and doesn't upset the aim of the telescope as changing eyepieces in the usual way often does. In freezing weather I plan to try substituting glycerine for oil.

"For convenience of representation, in the drawing, the spring-ball holder is shown opposite the large boss but, as Figure 3 shows, it actually is at one side of it. This permits the holder to be mounted nearer the main telescope tube.

"The eyepiece tubes were threaded into the turret while the whole assembly was mounted on a lathe arbor,

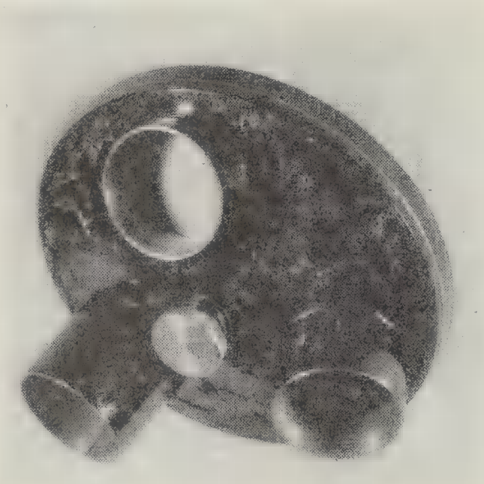

Figure 2: **Howe's turret rig**

consequently they are absolutely perpendicular.

"I am making a couple more for local TNs. I made my own patterns, and the castings from these cost me only 50 cents a set. Brass tubing was two bits and the remainder came from the scrap box."

While turning over files of telescoptical items from previous years, your scribe encountered an article from *The Journal of the Royal Astronomical Society of Canada,* Sept. 1937, in which H. S. McClung, of Regina, Saskatchewan, described what he calls the "corneal reflex test." Suppose, in the regular set-up for the Foucault test, that the lamp and pinhole were removed and a small ball were substituted for it, with a strong light somewhere in front but off to the side. Then the tiny reflection of the light on the curved ball would in effect become the pinhole. This, of course, has often been done; sometimes a drop of mercury is used, or a small marble of glass, or any spherical reflecting substance.

The ball used by McClung, however, is the ball of the eye itself. This permits the effective light-source—that is, the reflection of the lamp on this ball—to lie very close to the knife-edge, thus avoiding astigmatism due to separation of pinhole and knife-edge. McClung says the light used should be strong but need not be very small in area. This light may be a disadvantage, shining, as it would, in the eye when the latter was studying the subtle shadows on the mirror. It is also hard to hold the head steady enough to conduct this test, and McClung suggests a headrest. However, some may like it. Have many been using it, since McClung published it?

Years ago in this department there was a note about using the edge of the pupil of the eye as the knife-edge and dispensing with the ordinary one. This, too, required considerable steadiness on the part of the tester. Maybe some readers will want to compound these two. We don't necessarily recommend either one for regular testing but as a variation they are interesting—like riding a bicycle while standing on your head on the seat—that is, a bit tricky.

In this department, October, 1935, Joseph A. McCarroll, of Teaneck, N. J., described a penetrometer for reducing the hardness or softness characteristics of pitch to a quantita-

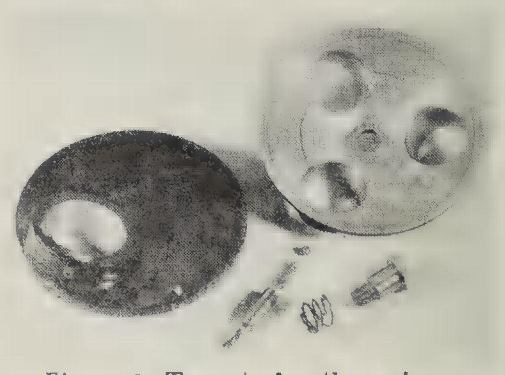

Figure 3: **Turret. Another view**

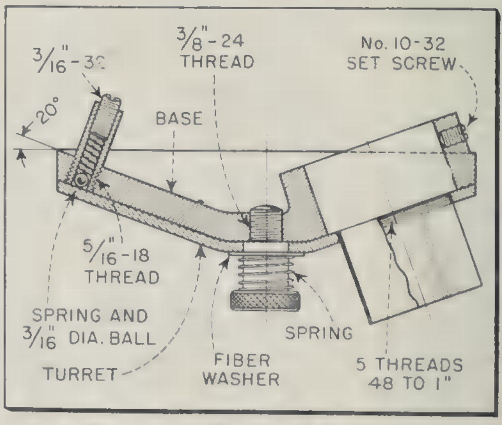

Figure 4: **Section of turret**

tive science, and, in the October, 1936, number, two more penetrometers were described. Now comes Robert E. Smith, D.D.S., Medico-Dental Bldg., Sacramento, Calif., with the one shown in Figure 5. It is made from sundry pick-me-ups, plus an optician's diopter gage to register the time-depth penetration of the point into the pitch at given temperatures. The point

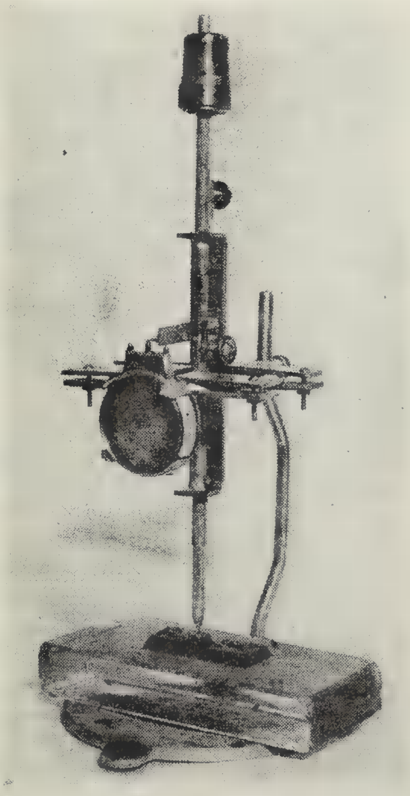

Figure 5: **Smith's penetrometer**

is shown above two pitch facets. Using this, Dr. Smith claims he knows all the time, as he works with pitch, where he is "at."

Among amateur glass polishers you can always get up an all-night argument about the merits and demerits of various pet fine-finishing abrasives. Here's a comment by D. Everett Taylor, 191 Prospect St., Willimantic, Conn.

"For a final step in fine grinding, before rouge, use extra fine emery in kerosene, as the grains break down easily and smoothly when so used and are much less likely to cause fine scratches."

With regard to Levigated Alumina he says, "This is a buffing flour for polishing metals and, for this purpose, it undoubtedly is tops, but when the microscope revealed that it had an extremely small grain size its use also for superfine finishing of optical surfaces was recommended. ["ATM," 4th edition, pp. 296, 493.—*Ed.*] If you are intent on using Levigated Alumina for fining glass surfaces, watch out for fine scratches."

Taylor states also that there is a glass removal of about a thousandth of an inch, between the kind of surface left by Carbo 600 and one sufficiently fined with fine flours, to be called ready for polishing. He says also that 0.0003" of glass must be removed in order to eliminate fine scratches of the kind that require magnification in

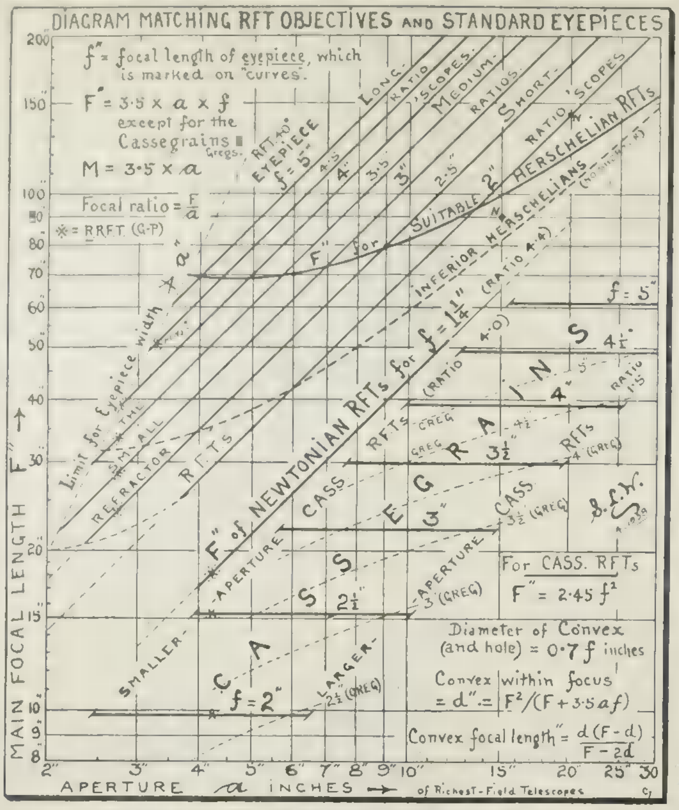

Figure 6: **Walkden's matching data**

order to be seen. Asked how he determined this, Taylor replied that the statement is based on a measurement of a lens before and afterward, using a Starrett micrometer.

Interest in Walkden's Richest-Field Telescope, or "RFT," continues, and many have been made. In the following contribution Walkden, whose address is 46 Cavendish Road, Harringay, London, N.4, England, discusses the matching of RFT eyepieces and objectives.

"If an amateur has an objective and wonders what eyepiece he needs to make it an RFT, he can get the answer from the accompanying diagram without even a calculation; or, if he has a few eyepieces or their lenses lying around and wonders how he could use one, if possible, for an RFT, the diagram again answers without calculation.

"A natural way of designing an RFT is to start with the aperture, a"; then decide on the focal ratio, c, then the focal length, F", and, finally, proceed to the eyepiece focal length, f", and the particulars of the lens. But among the eyepieces available is likely to be one not exactly but only nearly what is needed, and then, taking that nearest, we soon find ourselves working back to the main focal length and the aperture, in a matching process.

"Now the diagram of Figure 6 performs this matching process very quickly for every type of RFT—refractor, Newtonian, Herschelian, Cassegrainian and even Gregorian—and it also shows at a glance the various alternatives we might prefer to what we originally thought of constructing.

"Suppose, for example, we have in possession, or in makers' lists, a 1¼" RFT eyepiece. Looking at Figure 6, and at the sloping line for the 1¼" eyepiece, the eyepiece is seen satisfactorily to complete any Newtonian RFT of from 4" to 12" aperture, the proper focal length being read on the left-hand scale, where it is 4.4 times the aperture, agreeing with the formula near the top. The eyepiece *can* stretch over the range of 3" to 15" or even 20" aperture, but Newtonian RFTs of less than 4" aperture are not good, being too much choked by their flats; and Newtonians of 15" and 20" aperture are better with eyepieces of 1¾" and 2" focal lengths and main focal lengths of 92" and 140", and even then they hardly equal large Herschelians. While considerable margin is allowable, especially for eyes not very sensitive to the blind spot (image of the flat) in the center of the Newtonian's Ramsden circle, it is always as well to keep in mind that for an eyepiece of f inches focal length, the best aperture under the minimum-obstruction rule is given by $a = 4.9 f^2$ inches. But eyepieces of less than 1" should not, and over 2½" need not, be considered candidates for Newtonian RFT construction; and the apertures of less than 3", and even 4", are really not allowable. The "best" Newtonian line, $a = 4.9 f^2$ or $F = \sqrt{2.5\ a^3}$, may be seen to cross steeply the 1¼" eyepiece line at 7.6" aperture.

"If we have only the 1¼" eyepiece we should not think of any other RFT than a Newtonian of moderate aperture; but suppose the RFT eyepiece is of 3" focal length. This 3" eyepiece can be seen to complete any refractor RFT of over 2¼" aperture, of about the focal length to be read on the left-hand scale, 10.5 a inches, corresponding to the formula near the top. Or, paying regard to the thick Herschelian curve, the eyepiece will complete good Herschelian RFTs of about 5" to 10" or even greater apertures, all of the same focal lengths as refractors, or like the formula near the top.

"Should our preference be for a Cassegrainian RFT, the 3" eyepiece will complete any such RFT of 22" main focal length, ranging in aperture from about 5¾" to 14½", chosen larger according to experience and skill in figuring mirrors of small focal ratios when aided by Kirkham's scheme of using a spheroidal small convex mirror (see Scientific American, June, 1938). The formulas in the right hand lower corner may also aid the constructor; and the peculiarity of the Cass RFT may throughout be noticed, that the focal length of the eyepiece primarily determines only the *focal length* of the main mirror, leaving the aperture to be chosen from independent considerations.

"Should a Gregorian RFT be chosen (although it gives little reason for being liked), the 3" eyepiece will complete such an instrument, ranging from a 4¼" of 11" focal length to a 10" of 16" focal length.

"In another use often required of the diagram, suppose we have already decided on 6" aperture, and have the choice of several RFT eyepieces. Proceeding upward from the bottom of the diagram at 6" aperture, we can evidently have a 6" Cass RFT of 9.8" main focal length, employing an eyepiece of 2" focal length. And the Cass rules in the right-hand lower corner tell how the convex and the hole are both to be of 1.40" diameter; also how the convex is to be 1.85" within the main focal point, and be of 2.42" focal length. The alternative Cass RFTs of greater focal lengths, employing larger eyepieces, are easier to make, but they are less and less efficient.

"In 6" Gregorian RFTs we can have one of 10" main focal length, employing a 2½" eyepiece, but it is not a very good instrument. The alternatives of longer focal lengths, employing larger eyepieces, while easier to construct, are even less efficient.

"The 6" Newtonian RFT is one of 26" focal length, employing a 1¼" eyepiece, and is the useful handy kind of RFT which is perhaps the most liked, until the virtues of the Herschelians come to be further realized. Again, in connection with Newtonians, the 6" mirrors can be matched by others than the recommended 1¼" eyepieces. The 'best' eyepiece corresponding to minimum-obstruction design is always of focal length equalling $0.45\sqrt{a}$ inches, which is 1.10" for a 6" mirror, but the insensitiveness of some eyes to the blind spot in the Newtonian's Ramsden circle allows of considerable variation in the eyepiece focal length. When f is decided upon, the mirror must always be made of focal length $F = 3.5fa$ inches, and the flat be arranged according to the rule given in 'ATMA'. An aperture less than 3" or even 4" should not be assumed for a Newtonian RFT—and an aperture greater than 25" perhaps need not be assumed.

"The 6" Herschelian RFTs begin to be quite good at 63" focal length, employing a 3" eyepiece, but 72" focal length, using a 3½" eyepiece, proves better in definition. Only the fastidious might want still greater focal length employing a still larger eyepiece. It is curious to notice that the *larger* eyepieces go with the *smaller* Herschelian RFTs, contrary to the rule for the Cassegrainian and even the Newtonian RFTs."

As no 3" eyepiece is known to be available on the market, the amateur must make his own. For this, Walkden gives the following data on a Ramsden of the usual two plano-convex lenses. Focal length of each lens, 4". Distance of lenses apart, 2.67". Diam. of field lens, 2.31"; of eyelens, 1.3". Eye-hole distance suiting smallest need, 7/8". Eye-hole diam., ½".

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

Reissue

THE Supreme Court has held that a charge of patent infringement cannot be maintained against a defendant who acquired and used a machine subsequent to the granting of an original patent, which did not infringe that patent but which does infringe the claims of a reissue patent applied for subsequent to the time when the machine was acquired.

In the case in question a patent was obtained on a machine for treating nuts by mixing butter therewith so as to make them more appetizing. After the patent was issued the defendant purchased and used a machine for the same purpose which did not infringe the patent. Subsequent to the time that the defendant purchased the machine the patentee applied for and obtained a reissue of the original patent. The reissue patent was of broader scope than the original patent and several of the claims were infringed by the machine acquired by the defendant.

The controversy arose over the charge of the patentee that the defendant's machine infringed the reissue patent. The Court held that by acquiring the machine which did not infringe the original patent during the period between the granting of the original patent and the filing of the application for the reissue, the defendant had obtained intervening rights which permitted him to continue using the machine even after the time that the reissue patent was obtained. The Court pointed out that when the original patent was granted it was presumed that everything not claimed therein was dedicated to the public by the patentee and that anyone had a right to rely upon this presumption. Under the circumstances the patentee was held to be estopped to enforce the reissue patent against the defendant.

Privacy

A FEDERAL Court has recently sustained the right of a periodical to publish news articles describing the intimate details of the private life of a person regarded as a public figure.

A popular magazine published an article describing the life of a man, who in his childhood and youth, was widely heralded as an infant prodigy. The article described his early brilliance and accomplishments and the widespread attention and publicity which he received. It then described his general breakdown and the revulsion which he afterward felt for his former life of fame and study. The article pointed out that he attempted to conceal his identity and to escape publicity by choosing a career as an insignificant clerk.

Suit was filed by the unwilling subject of the article, contending that it constituted an unwarranted invasion of his privacy. The Court, however, disagreed with this contention and dismissed the complaint, holding that the article was not an illegal invasion of his right of privacy. In reaching its conclusion the Court first pointed out that it was not contended that any portion of the article was untrue. The Court conceded that it was "merciless in its dissection of intimate details of its subject's personal life." On this point the Court ruled, however, that the facts with regard to even the private lives of persons regarded as public figures had legitimate news value, and as such, could be published by a periodical.

The reasoning of the Court in reaching its conclusion is set forth in the following quotation from its opinion: "Revelations may be so intimate and so unwarranted in view of the victim's position as to outrage the community's notions of decency. But when focused upon public characters, truthful comments upon dress, speech, habits and the ordinary aspects of personality will usually not transgress this line. Regrettably or not, the misfortunes and frailties of neighbors and 'public figures' are subjects of considerable interest and discussion to the rest of the population. And when such are the mores of the community, it would be unwise for a court to bar their expression in the newspapers, books, and magazines of the day."

Bad Faith

IT has recently been held by the New York Supreme Court that a manufacturer, who falsely and in bad faith notified the customers of a competitor that he was the owner of a trade mark and that it was duly registered in the United States Patent Office, was guilty of unfair competition.

In the case in question the ownership of the trade mark was in dispute between two competing manufacturers. The trade mark was not registered by either of the manufacturers in the United States Patent Office. In spite of this fact, one of the manufacturers notified the customers of

the other that he had registered the mark in the Patent Office and that it was protected by the federal trademark laws.

The injured manufacturer brought suit charging unfair competition and the Court sustained the suit holding that the false notices, sent in bad faith, constituted unfair competition. While the injured party sustained a moral victory, and no doubt a certain amount of consolation from the victory, he did not receive any tangible recompense for his injuries. The Court held that the damages were of too speculative a character to be definitely ascertained and awarded only nominal damages in the amount of one dollar.

Inescapable

In a decision which is unusual only in that the conclusion reached is so obvious that a layman might wonder why it was necessary to obtain a judicial determination, it was held that a talking moving-picture is a moving picture. The owner of a copyright on a play granted the exclusive motion-picture rights in the play to a moving-picture producer who subsequently produced a talking moving-picture based on the play. It was contended by the copyright owner that the talking moving-picture infringed his copyright since he had not granted the right to use the dialogue.

The copyright owner argued that according to a custom in the industry the granting of motion-picture rights in a play did not in and of itself give the right to use the dialogue. The Court rejected this argument, however, pointing out that the copyright owner had granted the exclusive motion-picture rights to the producer and that a talking motion-picture was undoubtedly a motion picture.

In this connection the Court stated: "The plaintiff cannot escape the obvious conclusion that a talking motion-picture is a motion picture."

Paint Remover

A process for removing paint by means of infra-red rays was held to be patentable by the Court of Customs and Patent Appeals. The process consisted of generating a beam of infra-red radiation substantially parallel to the internal line focus of an elongated reflector, and then externally focusing the rays upon a paint-covered surface. The Patent Office held that the process was not patentable in view of a prior patent which disclosed the use of infra-red rays without a reflector for the removal of paint.

The Court reversed the Patent Office and held that the process as described above was patentable because it was not only new, but also produced useful and improved results over the old method which did not employ a reflector.

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

INTRODUCTION TO POLARIZED LIGHT AND ITS APPLICATION, by Martin Grabau, is a 46-page booklet that presents in compact form a complete survey of the principles of polarized light; it continues with brief descriptions of the uses of polarized light and the advantages that can be obtained. It covers a number of industrial applications. A bibliography points the way toward more comprehensive study. *Polaroid Corporation, Cambridge, Massachusetts.—50 cents.*

RECREATIONAL RESEARCH is a 64-page booklet which presents the findings obtained as a result of observing and studying various recreational projects. It deals with both historical and recent trends as well as the general sociological effects of leisure-time occupation. It also goes into such phases as economic effects, professional aspects, and personal health as influenced by recreation. *G. M. Glass, School of Health, Physical Education and Recreation, Louisiana State University.—$1.00.*

TENITE SPECIFICATIONS is a 28-page book that presents first a classification of the various types of this plastic and then proceeds to give in tabular form specifications regarding them. *Gratis to manufacturers, molders, and designers. Tennessee Eastman Corporation, Kingsport, Tennessee.*

FOTOSHOP HANDBOOK OF COLOR is a 102-page book containing a complete description of every type and make of color camera and accessory. The book also includes thorough laboratory instructions for all the popular color-printing processes, technical data on all films and filters, light and equipment related to color photography, a course in the fundamental principles of color photography and a complete supplement devoted to comprehensive reviews of books on color photography. The book includes five pages of natural color photographs by outstanding color photographers, printed in four colors. Stainless steel wire binding, cross-indexing with manila separators, periodic supplements without extra charge, moisture proof, chemically resistant cover printed in six colors, merchandise directory, are other features. Size 5¼" by 8¼". *Fotoshop, Inc., 18 East 42nd St., New York, New York.—$1.00, refundable on cumulative purchases totaling $10 or more.*

THE NURSING CARE OF PATIENTS WITH INFANTILE PARALYSIS, by Jessie L. Stevenson, R. N., understandably deals with the practical care of patients having that disease, and is furnished by the foundation which has been linked with the President's Birthday Fund. *The National Foundation for Infantile Paralysis, Inc., 120 Broadway, New York, N. Y.—Gratis.*

DEVELOPMENT AND MANUFACTURE OF OPTICAL GLASS IN AMERICA, by M. Herbert Eisenhart (President of the Bausch and Lomb Optical Co.) and Everett W. Melson, is a reprint of a technical article. *The authors, Bausch and Lomb Optical Co., Rochester, N. Y.—Gratis.*

MU-SWITCH is a 10-page catalog giving complete information on a series of switches that have wide industrial and experimental applications. These switches are of a type in which a very short movement of the actuating mechanism—only .001 of an inch—gives positive make and break. Through a reverse-action cross-center principle, the action of the contacts is sufficiently rapid to prevent arcing. The switches are available in a number of different styles having wide variety of purposes and are designed to handle loads up to two kilowatts. *Mu-Switch Corporation, Canton, Massachusetts. —Gratis.*

SUCCESSFUL FINE-GRAIN NEGATIVE PROCESSING, third printing, is an informative little handbook presenting a complete explanation of the process of fine-grain developing, stripped of technicalities. Included are detailed instructions for the actual development of an exposed roll of film. *Service Department, Raygram Corp., 425 Fourth Avenue, New York, N. Y.—5 cents.*

TRANSPORTATION PROGRESS, by Arthur Pound, is a 52-page reprint from "The Turning Wheel." It traces the history of self-propelled vehicles from earliest times down to the modern motor car. Included are a number of interesting drawings of ancient vehicles. An appendix lists milestones in transportation. *General Motors Corporation, Detroit, Michigan.—Gratis.*

SCREW MACHINE ENGINEERING is a new monthly periodical which should be of interest to all whose work touches in any way upon machine production that involves the use of turret lathes, chucking machines, and other equipment in the screw machine field. *Screw Machine Engineering, 34 West Main Street, Rochester, New York.—Subscription rate on application.*

THERMOCOUPLES is a 40-page catalog of assemblies, parts, and accessories which includes information of general usefulness on the correct choice of couples. Tabulated in easy-to-use form, this information will serve as a guide to the selection of couples for specific applications. Completely illustrated. *Leeds and Northrup Company, 4934 Stenton Avenue, Philadelphia, Pa.—Gratis.*

ANTI-AIRCRAFT coördination with the air forces of the United States (see page 311) is essential to an adequate aerial defense program. This month's cover illustration shows, foreground, an aircraft range-finder that works in close co-operation with the anti-aircraft guns, background. Photograph by Robert Yarnall Richie, taken at Camp Buchanan, Puerto Rico.

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SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

DECEMBER • 1940

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OUR *Point* OF VIEW

PLASMA TO BRITAIN

THE wealth and ingenuity of America face no insurmountable difficulty in rendering enormous aid to the valiant British. Well and good! We all do what we can, and our cheers go up as we note with what spirit our kinsmen across the sea make use of the weapons of defense we send them.

Some emotion deep within us stirs, however, when we read of a particular gift made, at this writing by some 6000 New Yorkers, to the British cause. The weapons we've shipped, defensive though they are, have to do with death while these 6000 donors have given life—something of both body and spirit—for they have given their blood. Three thousand quarts of their blood have been processed, put into blood banks for transfusions, and probably much of it has been shipped to England by this time.

It is appropriate to recall here the fact that blood banks were conceived by an American surgeon, Dr. O. H. Robertson, in France during the World War. A little added sodium citrate prevented healthy blood—drawn from the veins of others—from clotting, and it could be kept in bottles in refrigerators. Two to four weeks was its keeping limit, however, and, in transfusions, the patient had to be given a type to match his own. The former limitation would give us insufficient time both to collect and then ship refrigerated blood overseas; and the second added the danger that the seriously wounded person might die while his blood was being typed. Happily, these limitations no longer exist. A research group of the Rockefeller Institute for Medical Research has developed a way to extract from blood both the red and white cells, leaving only the plasma. And the plasma which we are now sending to the fighting British will keep for years, and may be transfused into any patient regardless of which of the four blood types he has.

Murderers and megalomaniacs may pervert to inhuman use some of the products of science, but here is one that cannot be so perverted. It is a life-giver, not a death-dealer. The process itself marks a milestone in the advancement of man's knowledge. But when so many persons utilize it voluntarily—under no compulsion of patriotism or self-preservation—to render precious aid to a friend, then does our faith in humanity receive a heartening boost.—*F. D. M.*

WHOSE FAULT IS IT?

NO ONE today even thinks of asking whether concrete will prove to be permanently acceptable as a material of construction. Of course it will. It will, despite certain observable faults.

For the past weeks the writer has been taking note of each piece of concrete construction, large and small, seen in the course of ordinary life—factory buildings, bridges, railway platforms, sidewalks, posts—not in any special capacity but as anyone having an ordinary interest might observe. It turns out that the job which has stood up even for a few seasons without extensive cracks, chunks spalled off, unsightly patchings and other evidences of deterioration, is rather exceptional. What or who is to blame?

Easiest, of course, is to blame the constructor. Maybe he cheated. Probably he lacked pride of workmanship. Perhaps he was ignorant of best methods, though ignorance about concrete is less common today among its users than it once was, thanks to years of instructional hammering by the Portland Cement Association and others.

Economics and machinery have exerted an interesting kind of control over concrete for the past half century, divisible into three periods: First, in the last century most of the cement used was imported from Europe and was expensive, but labor was cheap. It paid, therefore, to mix the concrete stiff, with just enough water to wet it barely; which in turn required laboriously ramming the non-flowing mix into place by hand. Such concrete has maximum strength. Some of these old jobs are still giving fine service.

The second period came with relatively cheap American-made cement but expensive labor. Stiff mix and hand ramming then passed out and most work was poured—too much of it at the water-weakened consistency of soup. Much of that work deteriorated.

Today we are in the third period: Cement still inexpensive, labor quite high but better methods available for placing less soupy, hence stronger, concrete; also, vibrating machinery is available for ramming it inexpensively. Much better work is being done but, even so, much of it soon looks mangy.

It is believed that if the ultimate people, largely the public, who pay for concrete work, and not merely the engineer, clearly understood only a few basic facts about it, higher standards of workmanship would result, since these can be attained wherever they are appreciated, demanded, and willingly paid for. The cleanness of the materials is not, as is so commonly believed, the most important factor in obtaining sound, strong concrete, though it still is very important. There are two other big factors. One is the amount of water used—the more water the less ultimate strength, in a ratio as great as three to one between stiff and soupy mixing. This of course takes more time and costs more money. The other is curing, something too often dispensed with altogether. After the concrete has set enough to prevent it from washing away, the surface is kept wet for some days, preventing the escape of the correctly proportioned amount of water needed within to combine chemically and permanently with the cement.

Concrete is a coarse material but it pays to be fussy with it.

These points may seem elementary to engineers, yet, when it is realized that there still are many persons in other lines of work who think the setting of concrete consists of drying it out, they may not be altogether out of place.—*A. G. I.*

50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of December, 1890)

DEFENSE—"It has for many years been patent to every one that New York City, with the great industrial forces and vast aggregate of wealth concentrated around what is known as the Port of New York, are entirely without defense against such an attack as might be made by the vessels of any first class power with but a few hours'

notice. . . A plan quite unlike anything heretofore attempted anywhere for the construction of forts for the defense of the ocean approach to the city . . . has been brought forward by Mr. John F. Anderson, a New York engineer, and consists in the construction, on artificial islands, of three forts, each with a diameter of 500 feet, between Rockaway Beach, on the Long Island shore, and Sandy Hook point . . . They would be about two miles apart, and the same distance from each shore, so as to command all the channels of approach, while being from twelve to fifteen miles distant from the city."

PIGEONS—"Efforts are now being made to introduce a carrier pigeon service into the United States Navy . . . War vessels employed in defending a coast are often without the means of transmitting information of the utmost importance to the mainland. By means of carrier pigeons they could send communications ashore over a distance of several hundred miles, signal the approach of the enemy's fleet, and report all his movements."

FIRELESS LOCOMOTIVE—"A fireless locomotive for use in mines . . . is provided with a tank that holds 0.550 cubic meter. The water is heated to 205° C. (or an absolute tension of 16 atmospheres) by a boiler placed on the surface; it is sufficient for a steady run of 3 to 4 kilometers."

ROPE—"Ropes sometimes wear out internally while apparently sound outside. This is caused by bending the rope over a sheave. In doing this the fibers slide a small distance upon each other and eventually wear out. In the best ropes this wearing out is prevented by lubricating the strand with plumbago, mixed with a small quantity of tallow, just sufficient to hold it in place."

LOG RAILS—"Mr. Angus McPherson of Cumberland County, Nova Scotia, has built 1¼ miles of railway into his lumber woods this summer and is now running a train on it. . . The rails he used are round spruce poles, six inches in diameter at the larger end, tapering down to half the size, and neatly joined at the ends. The sleepers are small round poles on which the rails are spiked. The rolling stock consists of a small upright engine, eight horse power, and two flat cars."

METER—"A new penny-in-the-slot contrivance has been adopted by the gas department of the corporation of Birmingham, for the benefit of small consumers. . . A sort of meter has been constructed, which, on dropping a penny in a slot, will deliver twenty-five cubic feet of gas."

BRIDGE—"The great steel bridge across the Columbia River, at Vancouver . . . will be 6,000 feet from the Washington to the Oregon shore. It will be double tracked, with a roadway on top for teams, and will be erected upon pneumatic piers. The pivoted pier, or draw pier, will support a draw which will give an opening of 200 feet space on either side for vessels to pass, and the span immediately south of the draw span will be 375 feet."

PATENT CENTENNIAL—"The wealth and economic prosperity of our country are so largely due to the system of patents, by which our inventors have been encouraged to pursue their unselfish labors, that among the many centennials which have been and are to be commemorated, the one hundredth anniversary of our patent system should not be overlooked."

BIG GUNS—"The chief of the bureau of ordnance, Gen. S. V. Benet, in his . . . annual report, notes that a twelve-inch breech-loading steel rifle is now nearing completion at the Watervliet Arsenal, and will probably be ready for trial in February. This is the largest size of modern gun we have yet attempted to manufacture, but the Watervliet plant is being put in shape by the government to turn out, also, sixteen-inch steel guns. These guns will be fifty feet long and weigh 125 tons each, requiring a full firing charge of 1,000 pounds of powder . . . and throwing a projectile over a ton in weight. It is expected that these guns will have a maximum range of about fifteen miles."

CHIMES—"Dr. Alva Owens, of Chicago, recently constructed . . . a set of chimes to be rung by electricity. . . Attached to each of the thirty bells hung on the rack above the key-board is an electro-magnet. The keys make the circuit from a battery in the base to the electro-magnets at the bells."

STEEL—"The Otis Steel Company, of Cleveland, which has the largest plate mill in the world, a few days ago rolled a 20 inch ingot of 8,500 pounds down to three-quarter inch plate with one heat."

BUILDING—"The new Masonic building now being erected in Chicago will be an architectural marvel. It is to have a frontage of 170 feet, a depth of 114 feet, and will be twenty stories high, and the roof will be nearly 300 feet from the level of the street. There are to be eighteen elevators, arranged in a semi-circle, having a total carrying capacity of 40,000 passengers daily."

SMOKELESS—"The basis of all the new kinds of smokeless gun-powder is cotton subjected to the action of nitric acid and the consequent formation of mono-, bi-, and tri-nitro-cellulose according to the strength of acid employed. . . This new powder is said to be on the average three times as powerful as the old."

Personalities in Industry

MARTIN L. DAVEY

Long before the poet wrote of trees, Martin L. Davey knew that they were creations to cherish—living things and, as such, amenable to curative processes. That knowledge led to the founding of an organization devoted to scientific shade-tree care that now does a business of nearly $3,000,000 annually.

Martin L. Davey was born July 25, 1884 in a small, rude home built with his father's own hands in Kent, Ohio. Young Martin started on his business career when he was six years old by peddling vegetables gathered from his father's truck garden. All through elementary school, he added to the family income and later financed his way through high school.

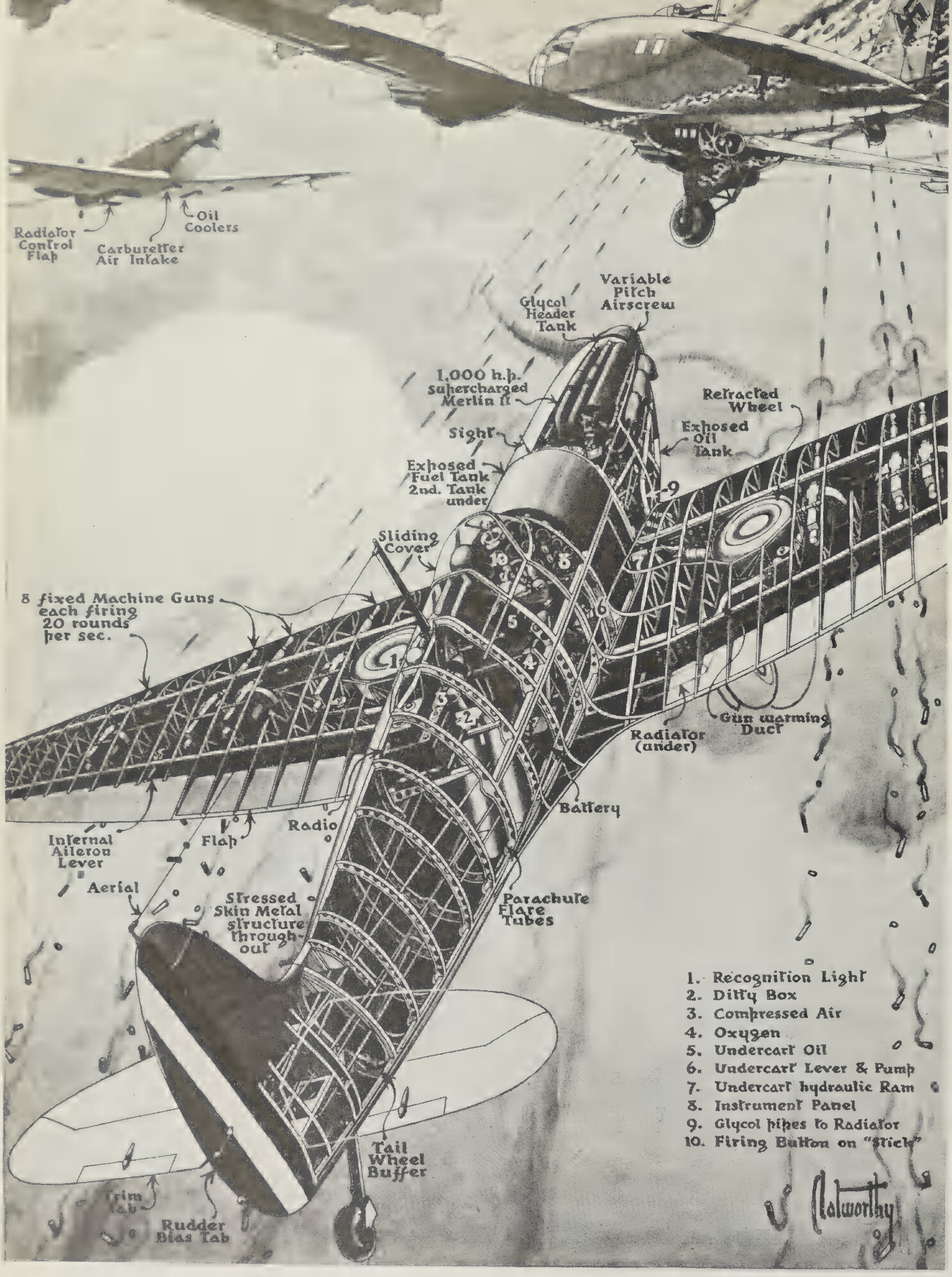
Martin had an exceptional father, John Davey, who has been called the "Father of Tree Surgery." His book, "The Tree Doctor," published in 1901, laid the foundation for the science of shade-tree care and awakened people to the fact that tree life could be preserved, nurtured, and maintained in healthy condition for the enjoyment of everyone. John Davey, the father, was something of a dreamer and idealist, and needed just the executive and administrative ability early displayed by his son, Martin. During Easter vacation in 1906, young Martin decided to join forces with his father, and left Oberlin College. At 22, he organized his father's affairs into an incorporated company and became general manager. He now is president of the Davey Tree Expert Company.

Though not a scientist, Mr. Davey has surrounded himself with a group of outstanding technical men. There has been constant improvement in technique, materials, and equipment. The moving of large trees has been one conspicuous development. Fifteen years ago, big trees were being moved on contraptions that resembled Spanish-American War artillery wagons. The Davey staff redesigned the equipment, using all modern aids to make it highly efficient: special metals added strength and reduced weights; a change was made from iron to pneumatic tires which cut into the ground less and have advantages of speed; the general mechanism was improved so that trees could be more readily and safely handled. A practical injection method for the successful treatment of chlorotic trees was developed, and, currently, injection experiments are being conducted with a view toward controlling serious tree diseases.

The battles Martin L. Davey has fought in behalf of shade-tree preservation have been waged not only for his own company, but indirectly for all other organizations in the same field, for his theme has always been: "Better and healthier trees kept in good condition by qualified experts." To give the best service to the public, Martin L. Davey started the Davey Institute of Tree Service in 1909. In its first year the school had a few students meeting in a hall over a store but developed into a three-winter course with a peak attendance of 447 employees. Most of the company's thousand field men and its 70 sales representatives are graduates of the school.

The company had little capital in its early days; no one cared to invest in such a "fool" enterprise as taking care of trees. There were scoffers aplenty but Martin L. Davey's faith in his father's ideas and in his own ability to translate them into actual practice for the benefit of tree life, admitted of no failure.

Politically, too, Martin L. Davey has had a successful career. At the age of 29 he was elected mayor of Kent, was twice re-elected, and at 34, while serving his third term, was appointed to fill the unexpired term of the Congressman for the 14th District of Ohio who had died in office. Twice nominated for Governor of Ohio, Martin L. Davey was elected on the second occasion in 1934 and was re-elected in 1936.



EIGHT STREAMS OF METAL STINGS

MANY times the British Spitfire has proved itself the deadliest fighter plane in general use during the present war. In this drawing, showing the plane cut away so that its equipment is visible, a Heinkel bomber is being slashed to pieces by a withering stream of bullets from the Spitfire's eight Browning (American) machine guns. Empty cartridges and links of the cartridge belts (which disintegrate on firing) stream behind from 160 shots per second. All eight guns are fired together by simple pressure of the pilot's thumb on a button on the "stick." Smaller, lighter, and slightly less maneuverable than the Hurricane, the Spitfire has a speed of 395 miles per hour. Some Spitfires have been mounted with shell guns, and all now have partial armor protection for pilots and tanks, such protection having been found on no crashed German planes. Super versions of both Spitfires and Hurricanes have recently been produced.

96TH YEAR

SCIENTIFIC AMERICAN

DECEMBER 1940

AIRPOWER FOR DEFENSE

Strategic Requirements of Aircraft in All Services

JAMES L. H. PECK

THE United States has been forced by world conditions to assume the defense of what is, to all strategic intents and purposes, half of the world. This involves the maintenance of strategic security of North and South America and, roughly speaking, the western half of the Atlantic and the eastern half of the Pacific—a tremendous task which even a two-ocean Navy and a 1,200,000-man Army could not accomplish without the aid of that greatest of modern weapons—airpower.

Our airpower is not made manifest by an independent air force, but by the Army Air Corps and the Naval Air Service; each of which employs particular types of planes that are best suited to naval and army operations. The Navy is immediately concerned with the control of the above-mentioned sea areas; it is our "first line of defense." Without such control, American commerce could be blockaded from points far removed from the coasts and beyond the range of shore-based aircraft. Our insular possessions, or those of friendly powers, could be occupied and used as enemy advance bases against us, and this could be followed up by the establishment of hemisphere bases from which the United States could be attacked by airpower assault and sea power "investment." Fortunately, the Navy in general and its air arm in particular are in a position to exercise control, in that they have immediate access to information concerning enemy activity in these sea areas and also the power to reduce such activity. Thus, the strategic requirements for our Naval Air Service craft are the ability to gain enemy information and the flexibility and striking power to counteract hostile operations.

The first assignment is delegated to the "big boats" — the huge, multi-motored flying boats known as patrol bombers—and the scouting squadrons of the Fleet's aircraft carriers. The Consolidated PB2Y-2 boats, 18 of which will shortly go into service to form a new patrol squadron, are our best type. Powered by four radial air-

NATIONAL DEFENSE

cooled motors, they have a range of more than 5000 miles carrying a nine-man crew and several tons of bombs. Their famous predecessor type, the Consolidated PBY boat, is the present first-line patrol bomber and has a range exceeding 3000 miles. Operating from the recently acquired Atlantic bases and those in Alaska and the Pacific, these long-range craft can effectively patrol our "half" of each ocean. On mission, the squadron planes fly in a fanned-out scouting line miles out of sight of each other but in a precise line maintained by radio contact and exact navigation. Even so small a number of craft can, in this manner, cover a remarkable amount of territory; they are in truth the "eyes of the fleet."

Not so far-sighted are those "eyes" represented by the carrier-based scouting squadrons, whose main purpose is to spy out advance units of the enemy fleet—submarines and cruisers or aircraft. The carrier's main function, however, is the fulfillment of the second Navy requirement—striking power, or the delivery of firepower —and to this end our floating airports accommodate Douglas TBD-1 torpedo bombers and Northrop BT-2 dive bombers. (Both scout bombers and patrol bombers live up to the second part of their designations once they spot the enemy, the big boats bombing from level keel at high altitudes while the scouts get right down to things by dive-bombing tactics.) The carrier fighter complement boasts such sterling combat planes as the Grumman F4F3 and the Brewster F2A-2 at present; a quantity of the sensational 450-mile per hour Grumman *Skyrockets* are on order.

The seaplanes carried aboard the Fleet's battleships and cruisers are employed for short-range scouting and range-correction; they are sent aloft from catapults, then land alongside to be hoisted aboard by cranes. Training planes of various types, and utility craft for the transport of personnel and matériel, are, of course, most essential. Marine Corps Aviation is an integral part of the Naval Air Service and operates therewith as well as in support of Marine ground units. It is of daily growing importance because of the apparent necessity of garrisoning both the new Atlantic bases and establishments in Central and South America.

WITHIN 100 miles of our coasts, the Army Air Corps takes over, and theirs is the big job of continental air defense, together with that of the Panama Canal Zone. Because of our long coastlines and the necessity for close co-operation with our neighbors to the north and south, it is vital that we have a powerful, highly mobile striking force that may, in whole or part, be shifted from one section of the country to another within a few hours. Such is the General Head-

Note the 37mm cannon in the propeller hub, and the tear-drop cockpit of this Bell P-39 Airacobra

quarters Air Force, which may best be described as an air force within an air force, since it consists of all the combat squadrons within U. S. borders. The GHQ Air Force may operate in close support of ground forces in the United States, Canada, or Mexico, in joint Army-Navy operations, or completely independent of land or sea units. Supplementing this roving "big stick," are several Air Corps tactical units in strategic points of the country, in the Canal Zone and the Hawaiian Islands; new establishments are under construction in Alaska and Puerto Rico.

BOMBARDMENT is the mission of airpower, the fist of the air arm, even as infantry is the fist of the Army. The Air Corps egg-layers are divided into three groups: Heavy Bombardment, Medium Bombardment, and Attack Bombardment. The former include the "flying fortresses"—so-called because of the amount and disposition of their defensive armament—that are capable of carrying huge loads of bombs for great distances. Outstanding of these are the four-engined Consolidated B-24's which have a range of some 3000 miles with a nine-ton bomb load. On shorter missions, with less war load, they have a top speed in excess of 370 miles per hour, and climb to the pursuit-ship altitude of 36,000 feet. Planes of the Medium Bombardment group are smaller, faster, and operate over shorter distances. The twin-engined Douglas B-23 and the 400-mile per hour North American B-25 are the newest types. Attack bombers engage in short missions involving strafing and dive-bombing of troops and stationary objectives. Twin-engined types such as the almost-400-mile Douglas A-20A carry fairly large quantities of bombs and armament; single-motored craft such as the Vultee YA-19 and Republic *Guardsman* do the dive bombing.

Reconnaissance aviation is charged with the maintenance of strategic security over land, just as the scouting force guards against surprise at sea. Due to developments in Europe, the Air Corps has discontinued use of the observation plane of medium range, as is evidenced by the lack of orders for the robin-breasted North American 0-47 series, the finest line of planes of this type ever built by any country. For distant reconnaissance, it seems safer to send the heavier - armed bomber, most of which have provisions for installation of aerial cameras anyhow. Liaison missions—the purpose of which is to maintain contact with ground units, keep the divisional command informed as to his advance force's location, progress, and requirements, and "warn" these units of enemy movements which might jeopardize them—and artillery "spotting" are best carried out by relatively slow craft or autogiros that can land on a roadway or nearby cow pasture during operations in the field. Latest and best of these "puddle jumpers" are the Ryan YO-51, the Stinson O-49, and Curtiss O-48, all high-wing monoplanes powered by radial engines.

Pursuit is the Air Corps' fighting force, and our combat planes are known as pursuit-interceptors and convoy fighters. The former types would go up to engage enemy bombers or observation craft in defense of a city or area and the convoy fighters would accompany bombers or reconnaissance planes on a mission in order to protect them against enemy pursuit. By the time this is in print, the Air Corps will have taken delivery on quantities of Curtiss P-40's, Bell P-39 *Airacobras,* Bell SM-1 *Airacudas,* and Lockheed P-38's. The first two are single-engined ships, while the SM-1 and P-38 are powered by twin Allison motors.

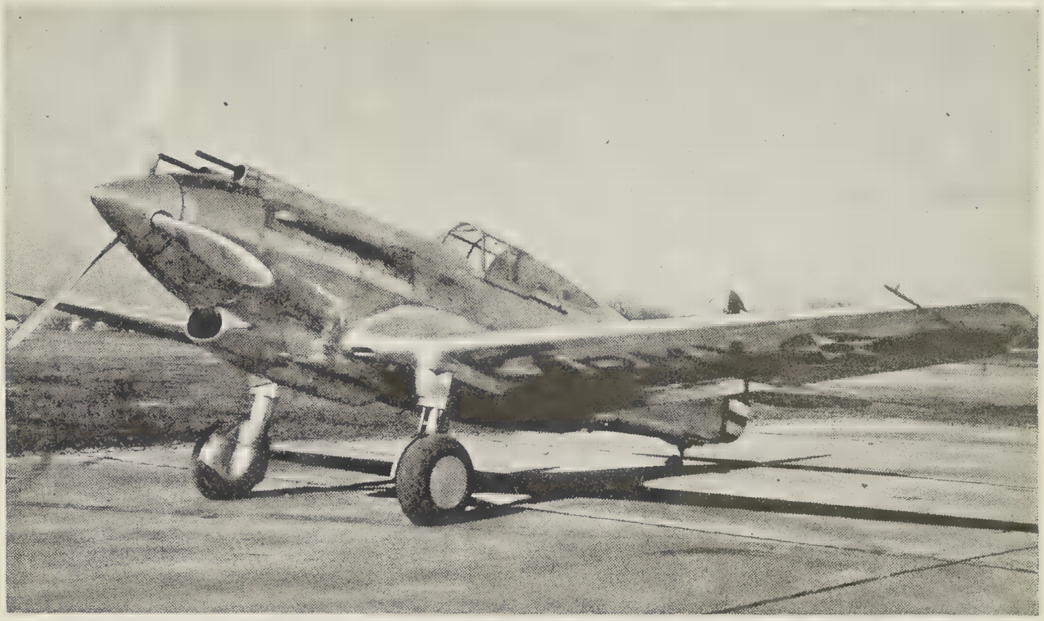
These Navy and Army aircraft are by far the finest in the world, but there are all too few of them. There are not enough pilots and ground personnel to fly and maintain the 25,000 Army and 10,000 Navy planes we hope to have by the end of the next fiscal year; nor are there adequate bases and airdromes on which to put them. Thus, the United States is concerned at the moment with the procurement of planes, engines, accessories and spares, and armament; pilots and combat crews—gunner-observers, bombardiers, navigators, and radiomen; mechanics, radio technicians, sheet metal workers and welders, armorers, parachute riggers, meteorologists, flight surgeons, and technicians and specialists of a dozen other callings—all of which are a pre-requisite of airpower. The

Planes and anti-aircraft must be coor-

airport program is at last under way.

We have mentioned the different types of craft used by both services to conform with the defense requirements of the Army and Navy. Fighters fight, and bombers bomb; but our warplanes are of diverse design and construction because of the difference in specifications and operating conditions. There are reasons, remediable and otherwise, why the services cannot seem to agree on a few basic designs. Standardization would, of course, greatly expedite production, and to this end the Aeronautical Board—a liaison agency headed by the chiefs of the Air Corps and Naval Air Service—is seeking to coördinate production methods, machine practice, aero research, and exchange of technical information. The principal difficulty arises from the "extras" which Navy planes must incorporate—"flotation gear"; specially treated, corrosion-resisting alloys; special radio equipment; nautical instruments and signalling devices; and personal essentials such as life jackets and emergency rations.

Carrier-borne aircraft are stressed to withstand the rigors of deck landings and arresting gear and the recoil shock of gunfire. These are "musts." An Army plane not so stressed, and unprotected against the deteriorating effect of salt water and spray would fall apart after a few months' carrier operations. Not so apparent are the reasons for different kinds of bolts and nuts on an otherwise identical pair of Wright Cyclone motors (differing hardware specifications), two inspection and testing routines, and separate sets of reamers, dies, collets, and so on for tooling. As if the machine-tooling bottleneck were not tight enough on general principles!



Powered by a 1200-horsepower Allison liquid-cooled engine, "several per day" of these Sterling-Curtiss P-40's are rolling off the production line

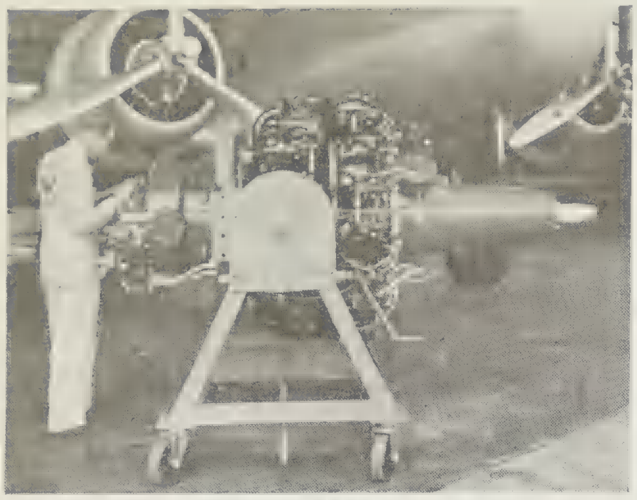
ated. This gun fires 25 shells per minute

SOMEWHAT less of a problem, but requiring more time per unit, is the training of air personnel. A swift fighter may be built in seven days; an embryo pilot must have that many months of training before he can safely fly this tricky, hot-to-handle ship. The Air Corps is well started on an ambitious program involving the training of 7000 pilots and 3000 bombardiers and navigators annually. Primary instruction will be continued at the nine Army-supervised commercial flying schools, some of which are opening branch schools to accommodate increasing quotas. Then aviation cadets will be sent to one of the three training centers for basic training, advanced and specialization work. Randolph Field, San Antonio, Texas, long known as the "West Point of the Air," is now called the Gulf Training Center; Maxwell Field, Montgomery, Alabama, formerly the home of the Air Corps Tactical School, is known as the Southeast Training Center; and the West Coast Center is located at Moffett Field, California. Cadets spend 10 weeks in the civilian school and 25 weeks at the training center, after which time they are sent to tactical units for active duty.

Navigators undergo three weeks of "elimination training" at one of the Naval Reserve Aviation Bases before they are sent to the Naval Air Station at Pensacola, Florida, to complete their aerial education. Because the Navy plans to train 10,000 pilots within the next two years, three air stations are under construction at Jacksonville and Opa-Locka, Florida, and Corpus Christi, Texas. Enlisted personnel and technicians receive their schooling at the Naval Establishment at Pensacola.

Air Corps mechanics, armorers, parachute riggers, instrument specialists, radio operators, and other enlisted men learn about maintenance of an air force at the Technical Schools at Chanute Field, Rantoul, Illinois, and Lowry Field, Denver, Colorado. Others are enrolled in seven Army-supervised civilian schools. These are the warbird's housekeepers. The Army's 3000 bombardiers and navigators will be tutored at the Pan American Airways school at Miami.

Neither Pan American nor the other airlines will step out of character further, because these carriers must bear the brunt of our stepped-up commerce if, and when, M-Day comes. Nearly as busy as the airlines are the service planes of the Utility branch. Cargo planes, transports for officers and enlisted personnel, and ambulance craft ply back and forth between bases and aircraft carriers on their errands of military mission and mercy. Newest of the transports is the Douglas C-47, of which a quantity have been ordered for the new parachute unit undergoing training in New Jersey.



Pratt & Whitney's 1850-horsepower engine. Extended nose facilitates streamlining

This 1940 has indeed been a momentous year, but within the coming year we shall witness even a more rapid march of aerial progress. Aeronautical research, genesis of airpower, in our N.A.C.A. laboratories, Naval Aircraft Factory, Wright Field, and that of the aircraft and engine manufacturers, is being extended in the quest of new aerial findings and methods for exploiting them. Most exhaustive of research is the actual war-testing of our various American prototypes; and we have already profited by experience. We have two types of leak-proof fuel tanks which are far superior to anything known to be in service abroad; we have the finest aerial armor plates, automatic shell cannon, and heavy caliber machine guns in the world; we have the only fool-proof bombing sight. America's warplanes, on which these accessories and armaments are being installed, out-perform by far any European War II craft of any type or model, and they are built to higher specifications standards and of materials that are vastly superior.

Anti-aircraft defenses, with which interceptor forces should be coördinated, are likewise improved; particularly the fire-control devices. Newest of these is the detector which utilizes the infra-red radiation given off by airplane engines, and concentrates this diffusion of rays into a visible image on a ground screen. The range-finder and Sperry-Wilson "predictor" automatically ascertain the altitude, speed, and course of the image—enemy plane—and the guns are fired accordingly. Experiments are being conducted with an infra-red ray searchlight, which may later be used in conjunction with this telescope detector. To assist further in aerial defense, the Aircraft Warning Service has been inaugurated to enlist civilian aid in the spotting of enemy planes.

It is highly probable that performance of our craft will be increased more than 10 percent during the coming year. Aerodynamical advances such as the remarkable Davis aerofoil—used to such advantage on the Consolidated B-24 heavy bomber—and engineering innovations should make this possible. The Lockheed P-38 is reported to have attained the long-sought 500-mile per hour mark at this writing, and the limit does not appear to be in sight.

It is not all sunshine, however. Productive industry is slow getting into high gear, perhaps through no particular fault of its own. The machine-tooling bottleneck is still seriously narrow, as is also the aircraft instrument situation. Skilled tradesmen are not plentiful. There is a surprising and unreasonable lack of Army-Navy air coördination, despite the efforts being made in certain quarters to alleviate this condition. There is far too much politics in defense in general and aviation in particular.

But we have surmounted higher obstacles. We inherit certain imponderable qualities with which America alone seems blessed these dark days. Spirit and morale which is inspired by the heart and feeling of a free people—not the sort born of extreme nationalism and propaganda ministries—and the mechanical heritage of the American youth supply him with the finest flying background obtainable; our excellent services furnish him with the finest training obtainable; our industry and engineering genius afford him the finest of equipment. This is the American Way. On land, sea, or in the air, it will be hard to beat.

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RUBBER DIE

Pad Used With Single Forming Die

By using a flat, thick pad of rubber in the fabrication of airplane parts, the Douglas Aircraft Co., Inc., has been able to lower die cost and speed production in line with our needs for national defense. When operating with this rubber pad, only one die is used and tooling methods are simple. The slabs of rubber are the largest pieces ever designed for commercial application by the Goodyear Tire and Rubber Company, weighing approximately 4000 pounds and measuring 160 by 57 by 11 inches. This development was reported in a recent issue of *India Rubber World.*

In application, the rubber is confined within a steel container which descends on a lower press table where many types of dies may be operated simultaneously. When the sheet metal is laid upon the rubber slab and pressure is applied, the rubber conforms to the shape of the dies, thus forming and blanking metal sheets into their desired shapes.

The Guerin process, as it is known, makes possible an exceptionally high strength-weight ratio by forming sheet metal quickly into a rigid structural part, eliminating the need of stiffening members.

DIVE-BOMBER

The United States Navy is testing out a new all-metal Curtiss-Wright dive-bomber, the XSB2C-1. Greater range, increased machine-gun fire, higher speed, heavier bombs, are all claimed for this machine, although beyond a statement that a 1700 horsepower double-row Cyclone is to be employed, no details are given. The artist's drawing hints at flaps to retard the dive, wheels completely retracted and drawn up and sideways into the wing, and bomb bays with bombs carried horizontally under the belly of the fuselage.—*A. K.*

Just after bomb release

BROWSING with the Editor

THROUGH THE SCIENCE LITERATURE OF THE WORLD

NAZIS' POOR "GAS"—Gasoline used to power German airplanes in general is from 70 to 80 octane rating, equivalent to our standard grades of motor fuel, whereas the RAF has aviation grades of gasoline, thus in part accounting for the apparent superiority of the British fighters.—*Oil Weekly.*

UNBREAKABLE SPECS—Eye-glasses are worn by one football player, Thatcher Longstreth of Princeton. These are of the contact lens type.—*Visual Digest.*

TUNNEL MILEAGE—There are 1539 railroad tunnels in this country with an aggregate length of 320 miles—Notes, Association of American Railroads.

WE USE MORE SNUFF—The average person, thinking of snuff-taking as a rather ancient habit, will be surprised to learn that from a little less than 4,000,000 pounds in 1880, production jumped to 41,000,000 pounds in 1929. Nowadays, however, snuff is used generally like chewing tobacco.—U. S. Department of Agriculture.

QUIETER CARS—About 400 pounds of rubber, in 1009 rubber parts, are used in the modern streamlined trolley car which is built to the specifications of the President's Conference Committee of the street railway industry.—*India Rubber World,* September 1, 1940.

GELATIN ENERGY—There is no evidence that gelatin cocktails are harmful in themselves, but it is yet to be scientifically proved that they do us any good.—Dr. Iago Galdston, in *Hygeia,* October, 1940.

LIGHTNING STRIKES TWICE—Lightning struck the Empire State Building at least 20 times during the period between April and October, 1940. Because the building is properly grounded no damage resulted.—Notes, General Electric Company.

SMALLER THAN BACTERIA—It would take something more than 5,300,000,000,000,000 smallpox viruses to weigh one ounce.—Dr. Thomas M. Rivers, Rockefeller Institute for Medical Research.

ACRES OF RAILROADS—Approximately 4,000,000 acres of land, equal to about one sixth of the area of Indiana, are used by the American railroads for rights-of-way, yards, shops, station grounds, and other transportation purposes. —Notes, Association of American Railroads.

NITRATES—Preliminary results of an experiment at Woollongbar Experiment Farm have shown that, following a short fallow, the nitrate nitrogen content of the soil is considerably increased. Half of the experimental plots were fallowed for about two months, the other half remaining under pasture. Analysis at the end of the above period showed that the plots under pasture contained an average of 4.5 parts per million of nitrate nitrogen while the fallowed plots averaged 60 parts per million.—*The Agricultural Gazette of New South Wales.*

HIGHEST TEMPERATURE—The highest man-made temperature on record—18,000 degrees, Fahrenheit—has been produced by Dr. C. Guy Suits. This is twice the temperature of the Sun's surface.—Notes, General Electric Company.

PHYSICALLY UNFIT—Approximately one third of the men examined for World War service, reports Dr. W. S. Leathers of Vanderbilt University School of Medicine, were physically unfit for military duty.—*Science Service,* October 8, 1940.

HELIUM—More than 100,000,000 cubic feet of helium have been produced at the U. S. government's plant, only one in the world, in 11 years of operation. That quantity is sufficient to inflate nearly 20 monster airships, such as the ill-fated *Macon* and *Akron.*—Science Service.

FAST WINGS—Hummingbirds' wings beat 75 times a second in flying and 55 times a second when the bird is hovering. The bird's flight reaches a speed of nearly 50 miles an hour.—Dr. Winsor M. Tyler, Smithsonian Institution.

RESEARCH PAYS—A survey made by Dr. Karl Compton, Chairman of the Advisory Committee on Scientific Research of the National Association of Manufacturers, showed that out of 188 companies covered in the survey, 10 companies spend more than 10 percent of their gross income on research, while the average spent is about 2 percent. Leaders in research at the present time are manufacturers in the aviation industry.—*Journal of Applied Physics,* September, 1940.

1000 WELLS PER MONTH—More than 1000 wells are drilled each month in the United States in seeking oil. These are from a few hundred feet to more than two miles deep and run in cost up to $250,000.—*Oil and Gas Journal.*

TONS OF DUST—Dust storms carry tremendous amounts of material. It has been calculated that during some of these storms 126,000 tons of dust per cubic mile of air is lifted and carried by the wind.—Blackwelder and Barrows "Elements Of Geology."

RAYON TIRES—Rayon cord tires have given as much as 30 times the mileage of ordinary cotton cord tires in special tests under extreme conditions. In one overloaded, high-speed run in a hot country, rayon tires lasted 80,000 miles while ordinary tires wore out in 3000.—William H. Bradshaw, E. I. Du Pont de Nemours & Company, Inc.

INCUBATION—Both the Egyptians and the Chinese knew how to hatch chicks artificially more than two thousand years ago, using crude equipment and laborious methods. —Clip Sheet No. 1158, U. S. Department of Agriculture.

SILVER STERILIZES—Silver as a sterilizing agent for drinking water may be used in the ratio of one part of silver in 10 to 20 million parts of water to render the water safe for human consumption. The cost would be but $2 to $4 per million gallons of water.—Dr. Alexander Goetz, California Institute of Technology.

FOREST RED—Green fields and forests emit a ghostly red light. Though this is invisible to human eyes except with special instruments, it is of fundamental significance in the study of the basic physical process of life on earth.—Drs. E. D. McAlister and Jack Myers, Smithsonian Institution.

Government-Made Addicts

The Federal Alcohol Administration Still Follows an Ancient Tradition — Blindly

YANDELL HENDERSON, Ph.D.
Professor of Applied Physiology at Yale University

In the United States now the number of alcoholic addicts—the men each of whom consumes a quart bottle of whiskey, or more, every day—is quite constant; and quite constant, also, so far as can be estimated, is the number in each of our 48 states. In each the number of new addicts produced each year balances closely the number that die. In nearly every one of the 48 the system of liquor control differs in some details from that of every other state. Yet these 48 supposedly differing experiments produce no appreciable differences in results. Evidently, then, there is some fundamental factor that is the same in all these experiments, and that dominates the results in all: some factor that prevails throughout the entire nation, and reduces all the 48 experiments to one. That factor is the high "proof," or alcoholic content, of our distilled spirits, chiefly whiskey, which is the same throughout the nation. The Federal government alone controls that factor.

Under Prohibition even the weakest liquors were forbidden. Under the system to which we have reverted, and which is now maintained by the Federal government, distilled liquors of low or even moderate strength are virtually prohibited and only those of high alcoholic content are permitted to be labeled and sold as whiskey and other distilled liquors. The underlying idea is that it is the duty of the United States government, through its supervision of interstate commerce, to guarantee the quality and quantity of all foods and drugs. It is held that the American citizen should receive full value for his money, whether he spends it for a can of tomatoes, a bottle of medicine, or a bottle of whiskey. Accordingly, we have not only the Federal Food and Drugs Administration, but also the Federal Alcohol Administration; and under the regulations which this Administration is authorized to make and enforce, no liquor of a strength below 80 proof—or 40 percent of alcohol by volume—can be labeled or sold in the United States as whiskey, gin, rum, or brandy. In 48 states all kinds of experiments and efforts in endless variety are made to ameliorate what Lloyd George, its greatest ameliorator in England, called the "drink trouble;" and all are effectively counteracted by the Federal government, by its maintenance of this high proof requirement.

How this condition came about is briefly as follows: In Colonial days our ancestors on the Atlantic Coast drank rum made from East Indian sugar or molasses. But, when they moved west of the Allegheny Mountains, the difficulty and expense of transportation promoted the development of a local distilling industry that made use of grain—chiefly Indian corn. When President Washington appointed Alexander Hamilton as the first Secretary of the Treasury, and Hamilton began to repair the almost bankrupt treasury, he looked about for sources of federal revenue. He established a tariff on imports and by act of Congress laid a tax of 10 cents a gallon on whiskey. Thereupon the Whiskey Rebellion broke out in western Pennsylvania; and President Washington used the armed forces of the Government for the first time under the Constitution to suppress it.

The excise men then collected a part of the tax, but the distillers evaded a part. Alcohol costs little to make; but water is still cheaper, and two gallons of whiskey were easily diluted to three. There were few chemists to analyze the liquor and determine its concentration of alcohol. It was sufficient as a test of alcoholic content to moisten gun powder with the liquor, and try to light it. If the content of alcohol was high enough, and the content of water low enough, to permit the powder to burn, that was "proof," or "100 proof." If the moist powder would not burn, the liquor was "below proof."

To meet this practice, the Government applied a measure that stopped the loss of revenue due to watering, and made 100-proof whiskey—that is 50 percent of alcohol by volume—the standard American liquor. It thereby did more than any other factor in American life to maintain for 150 years a steady production and reproduction of alcoholic addicts. The law specified the same tax "on each proof gallon or wine gallon below proof." The distiller could dilute his liquor, but if he did he must pay the same tax on the water that he added to the barrel that he did on the original contents of the barrel.

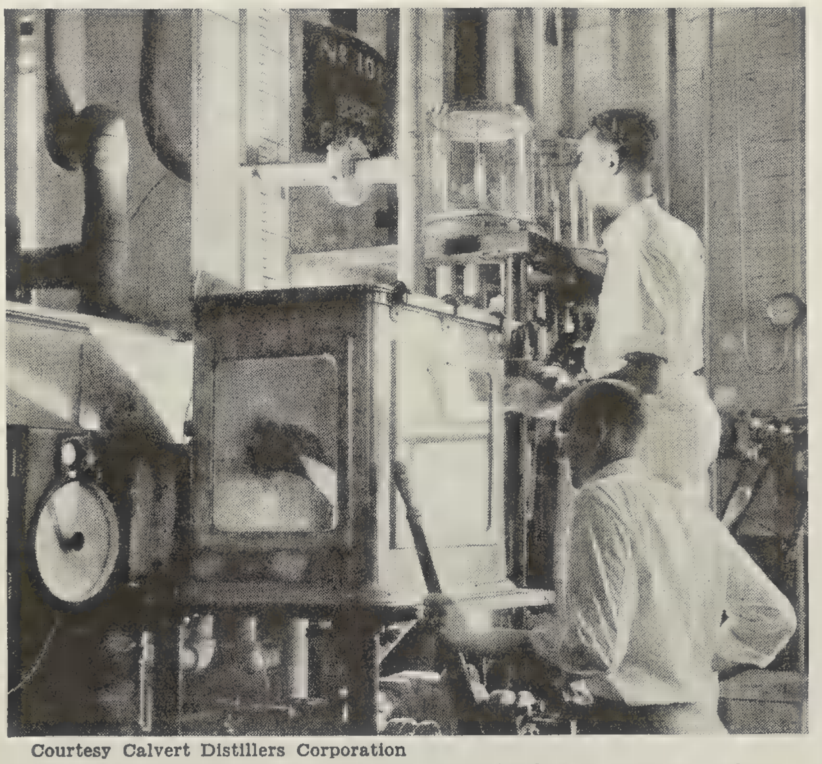
Now the term "wine gallon" has nothing to do with wine. The first distillate from a primitive pot still was a liquor low in alcohol and was called "low wines." It was redistilled to produce a liquor higher in alcohol and called "high wines." Hence the expressions "wine gallon" and "proof gallon," which are both just a gallon in volume, but of different alcoholic content, and hence the practice of the Government of basing the federal excise on the "proof gallon" and taxing a "wine gallon" at the same rate, which has served effectively—and unfortunately—to hold American liquor up to high degrees of proof ever since. Even when it was allowed that, after the tax was paid, the liquor might be diluted to 80 proof—40 percent of alcohol—the idea persisted in the popular mind that whiskey, to be whiskey, must be of high proof—as it is to the present day.

History records several cases in which entire nations have within a few years developed a wide-spread addiction to extreme degrees of alcoholism. In all such cases the cause has been the introduction into popular consumption of high proof spirits with low taxes, or none. This occurred in England in the reign of Queen Anne. England was at war with France, and was allied with Holland. So French wines were so far as possible excluded, and "Hollands," or gin, was favored as a sign of patriotism. Even when a low tax was imposed, it was largely evaded by smuggling. As a result, habitual drunkenness be-

came appallingly general. The cause and condition were shown by a popular sign on an inn in a poor district: "Drunk for a penny; dead drunk for two pence; clean straw" (in which to sleep it off) "for nothing." And generations of higher taxation and strict control only gradually overcame the general intemperance of the English people: indeed, it lasted down to the War of 1914-1918.

If a low price and high alcoholic content tend to promote intemperance, there is equally strong evidence that high price and lower alcoholic content tend strongly to decrease intemperance. Lloyd-George, as Minister of Munitions, in 1915 found that heavy drinking by the workers interfered with the production of munitions. Accordingly, by act of Parliament, the distillers were allowed to dilute spirits much more than ever before; and the taxes were adjusted so as to make it profitable for them to do so. As an outcome, "The weekly average of convictions for drunkenness in England and Wales, which in 1913 were 3482, had, by the first part of 1917, fallen to 929." And the same general policy has been continued ever since, with the result, as Lloyd-George reports in his Memoirs and others confirm, "Britain today is a much more sober country than it has ever been in my memory." Government reports show that convictions for drunkenness per 10,000 of the population in 1938 were only 23 percent of those in 1913.

In recent years the tax on liquor for consumption in England has been about $13 per American proof gallon: contrasting with about $3 a gallon for federal and state taxes together in this country. But this high British tax has been compensated to some extent for both producer and consumer by the allowance of a degree of dilution that makes "Scotch" in England a milder drink than "Scotch" in America, where it must meet our taxes and required concentration. Under the British taxes and concentration the distillers make a satisfactory profit; the consumers are satisfied with their distinctly milder liquor; and the American visitor, finding that he can drink more than at home without serious effects, concludes that "it must be the climate." The benefit is further enhanced by the fact that "Scotch" is always further diluted with "soda" by the drinkers; it is almost never drunk "straight," as is often the case with those in America—especially automobilists—who drink American whiskey direct from the bottle.



Courtesy Calvert Distillers Corporation

Today, alcohol concentration in whiskies is proofed with a hydrometer as it leaves the still, not with gun powder

Thus in Britain a high tax rate and a large legal degree of dilution have made it to the interest of the distilling trade to decrease the intoxicating quality of their product and thereby to decrease to a more than proportional extent the evils associated with it. In America, on the contrary, the system has always been one of low taxes, cheap liquor, and high alcoholic content: a system under which the distilling industry has found little incentive to develop a market for lower proof liquors. Yet it is quite certain that, until the federal government adjusts its taxes upward and the permissible degree of concentration downward, so that it will be to the financial advantage of the industry to offer and advertise lower proof liquors at prices that will contrast favorably per gram of alcohol with those of higher proof, the production of alcoholic addicts and other evils will not be lessened: no matter what the 48 states may do.

Even this is not the whole story of American maladjustment in liquor control. There is another important item: the bootlegger. One of the arguments adduced in support of low taxes on proof spirits is that higher taxes have always tended to promote the manufacture and sale of illicit liquor. The government needs all the revenue it can get from the excise on spirits. It makes strenuous efforts to discover and suppress the moonshiner, the bootlegger, and the smuggler. Yet, at the same time, by its unwise system, it has promoted the very conditions that it wishes to suppress. It habitually penalizes the legal liquor industry in its competition with the bootleggers. It forbids the legal manufacturer and dealer to sell any liquor below 80 proof, while the illicit manufacturer and dealer can, and does, dilute his liquor to any extent that his market will tolerate, which is commonly between 60 and 70 proof: rarely higher. And the fact that illicit liquor is commonly diluted to 70 or below is decisive evidence that Americans are like Englishmen in that whiskey below 80 proof would be acceptable. What 70 proof is on the tongue is shown by comparing our 70 proof bootleg liquor with cocktails; for 35 percent of alcohol, or 70 proof, is the strength of a dry Martini; and this, by the way, is about the highest concentration that can be taken habitually without destroying the mucosa of the stomach. No one can fairly complain that he gets "no kick" from a 70 proof drink.

Editor's Note: *Professor Henderson's special competence to write on the subject dealt with above arises from the fact that he is an outstanding scientist and that one of his special fields of research long has been the physiological and social aspects of the liquor problem. Others are physiology of the circulation, bio-chemistry of respiration, and pharmacology of gases. He was one of the organizers of the Chemical Warfare Service, is the author of a book on industrial poisons, entitled "Noxious Gases," determined the standard of ventilation for the Holland Tunnels, and was the scientific authority on whose advice Congress legalized 3.2 beer as non-intoxicating under Prohibition.*

For a fuller discussion of the

subject of the above article see a paper by the same author, in the new Quarterly Journal of Studies in Alcohol, *Vol. 1, Page 1, Yale University Press, 1940.*

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RADIO KNIVES

War Casualties

May Benefit

MEDICAL science has made such great strides since the World War that already we hear of the use of new techniques in the treatment of wounded in the present war. Recently, at a meeting of the Military Surgeons of the United States, Col. Gustavus H. Blech suggested that American Army Surgeons will in future use radio-knives on army wounded instead of scissors and scalpel. This method is particularly advantageous for wounds of the extremities.

"I am sure," Col. Blech said, "that in the light of recent experience we should not only provide regimental surgeons with adequate surgical equipment but simplify the scheme of organization for field service by having fewer units but those to be staffed and equipped for all surgical operations permissible in the zones of combat."

NERVOUS

Faulty Sugar Chemistry

May Cause Mental Diseases

FAULTY sugar chemistry in the body may be one cause of mental and nervous diseases, Dr. G. Wilse Robinson, Jr., and Dr. Prior Shelton, of Kansas City, Missouri, recently reported in *The Journal of the American Medical Association.* Patients on the verge of a nervous or mental breakdown might, therefore, be helped by treatment of such a condition.

Signs of sugar disturbance that could be considered diabetes were discovered by these doctors in a high percentage of patients when first admitted to a hospital for mental disease. From one third to nearly two thirds of the patients appeared from the tests to have diabetes. The patients were suffering from all types of mental and nervous diseases, including alcoholism. Tests on these patients several weeks after they entered the hospital showed normal sugar chemistry in one fourth to one half of the group, although only one patient was given treatment for diabetes.

From their studies, the doctors conclude that faulty handling of sugars and starches is common in nervous and mental patients and that it may be a cause of the abnormal nervous and mental condition.

SIDE VISION

Eyesight Measuring Device

Detects Unsafe Motorists

A DEVICE developed by the American Optical Company detects faulty side vision. For safe driving, one should be able to see a moving ob-

ject at an angle of 90 degrees while his eyes are looking directly ahead. The perimeter instrument shown in our illustration measures accurately the entire field of vision. It also is used in the diagnosis of eye and brain diseases.

PINK ELEPHANTS

So It Wasn't Primarily

The Drinking

ALCOHOL is "not the principal factor in the production of delirium tremens," three Providence, R. I., physicians, Dr. Hugh E. Kiene, Dr. Robert J. Streitwieser, and Dr. Himon Miller, seem to have proved in experiments reported in *The Journal of the American Medical Association,* as reported by *Science Service.*

Vitamin B_1 banished the pink elephants in short order, twice as fast as usual, even though the patients in their experiment continued to drink a quart of whisky daily. These five patients were seeing every animal in the Barnum and Bailey outfit, according to one of them, when admitted to the hospital. They recovered, on the average, in 2.4 days on a treatment of large doses of vitamin B_1, plus a drink of four ounces of bonded rye whisky every three hours, day and night.

Signs of kidney irritation in two of the patients disappeared within three days under the vitamin treatment, even though the patients were continuing their daily quart of whisky—from which the physicians concluded that vitamin B_1 acted directly on the kidneys in such a way as to indicate probable curative powers.

The fact that recovery from acute symptoms of delirium tremens occurred practically twice as fast when vitamin B_1 was injected into the patients' veins, even in the presence of continuous drinking, indicates, the Providence physicians state, that the cause of the condition is primarily a deficiency of the vitamin in the presence of a deranged sugar-starch chemistry in the body.

Reason for the vitamin deficiency which brings on the pink elephants is the fact that the person who gets delirium tremens has a habit of failing to "stop for adequate dietary foods in his alcoholic meanderings after the first 12 hours."

PROMISE

New Synthetic Cleansing Agents

Threaten Germs

DISCOVERY of the germ-stopping power of modern synthetic soaps and shampoos may provide scientists with a new class of chemical weapons against disease, including tooth decay, according to *Science Service.* Experiments in this direction are now under way at the University of Chicago, by Dr. Benjamin F. Miller and Dr. Zelma Baker.

Three of the cleansing agents, with the trade names Damol, Emulsol-605, and Emulsol-606, are relatively non-poisonous and non-irritating to mice and rabbits. They stop the growth of germs in the test tube. Their protective action towards experimentally induced germ diseases is now being investigated.

One of the cleansing compounds, Zephiran, is being tried as an anti-tooth decay weapon. The germ-

killing power of this substance was announced by Prof. G. Domagk, of Germany, the man who gave sulfanilamide to the world. Trials of Zephiran by the Chicago scientists showed that it promises to fight tooth decay in two ways: by killing germs and by stopping production of lactic acid which, in high concentration, can destroy tooth enamel and thus give decay a chance to start.

The new cleansing agents were developed to meet various special demands of industry. More than 1000 of them have been patented within the past decade. They have long, chemical names. Zephiran, for example, is alkyl dimethyl benzyl ammonium chloride. Another, with the trade name of a much advertised shampoo [Drene. —*Ed.*] is triethanolamine lauryl sulfate. One of them is sulfonated castor oil.

RISK

Dangers From Hormones In Some Cosmetics

DANGERS besides the possible development of cancer may result from indiscriminate use of sex hormones and vitamins in cosmetics, Dr. Joseph Eller and Shirley Wolff, of New York City, warn in a report in the *Journal of the American Medical Association*. Dr. Eller and associates point out that a commercial face cream containing a female sex hormone produced cancer in animals as well as other profound changes when applied on the skin in one fifth of the amount recommended for daily use by women.

SOFT CORNS

Operation on Toe May Be Needed

A BONE-CUTTING operation for relief of soft corns has been devised by Dr. H. B. Macey, of the Mayo Clinic. The anatomy of the fourth and fifth toes make ideal conditions for the development of pressure on a bony prominence which leads to callus formation, Dr. Macey explains. Soft corns, situated between the toes, generally between the fourth and fifth, are calluses. Their softness arises from their confinement between the toes and the associated moisture of the feet.

One of the bones of the fourth toe often ends with a bony prominence or bump pointing toward the fifth toe. The opposite bone of this toe may also have a prominence. Short, narrow-toed, forward-pitching shoes may cause one if not both of these bony prominences to press on the flesh between, with a callus resulting.

To relieve the condition, the prominent portion of the bone of either toe may be removed by operation. The prominence must be removed smoothly and cleanly so that no sharp points are left to cause further trouble. — *Science Service.*

ARCH SUPPORTS

Scientifically Correct, Made of Plastic

LIGHTWEIGHT and sanitary arch supports designed for foot comfort and scientific precision in correcting ailing feet won a major award in the Scientific group of the Fifth Annual Modern Plastics Competition sponsored by *Modern Plastics Magazine.*

Designed by S. Sydney of the National Foot Appliance Laboratory, New York, these arch supports are made from a plaster of Paris impression of the foot as taken in the practitioner's office of the physician or chiropodist (podiatrist). Sheets of Tenite II are molded by Insulation Manufacturing Company and from these sheets pieces are cut to size. Under heat and pressure they are shaped into supports that are odorless; low conductors of heat; resistant to discoloration, tarnish, stains, and moisture; and that do not warp. Any type of arch support can be made by this method.

Plastic arch supports, shaped over plaster of Paris impressions, can be made in any type, or with metatarsal combination

People allergic to steel or leather will find these plastic arch supports to be the solution to their problems of irritation and skin disorders. Smooth and pleasant to the touch, the surface will not tear sheer hose.

LOWER MORTALITY

From Intestinal Ailment

INTESTINAL obstruction has long been one of the most serious disorders of the digestive organs, with a mortality rate which has remained at approximately 40 percent for more than 50 years. Today, however, says Dr. William Osler Abbott, of the University of Pennsylvania Medical School, marked success in treating this condition is being achieved through a variety of ingenious new methods, and mortality rates in several large hospitals have fallen to 7½ and 11 percent.

SURGICAL RAYS

Ultra-Violet Lamp Aids in Cataract Surgery

HERE'S good news for persons slowly going blind from cataracts. Greater efficiency in cataract surgery has been made possible by the development of a new ultra-violet lamp for use in cataract cases where the diseased lens of the eye has to be removed by operation.

The new lamp, developed by the American Optical Company in collaboration with Dr. Eliott B. Hague, noted eye specialist, is the first one designed exclusively for cataract surgery. It provides the greatest source of fluorescing ultra-violet now available for cataract operations, which comprise approximately 25 percent of all eye operations.

The lamp projects a full beam of ultra-violet light of maximum intensity at 3650 Angstrom units. Directed into the eye, this light causes the crystalline lens to fluoresce. As a result, the lens becomes brilliantly visible, a distinct help in cataract surgery. Furthermore, the lamp insures total extraction of the lens as any remnants, which may later cause trouble, are easily located because of their fluorescence, and extracted.

What Is On Venus?

Newest Evidence Hints Venus is Clothed In Dense Clouds of Polyoxymethelene Hydrates

HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

VENUS—the most conspicuous of the planets—is in many ways the most disappointing to the astronomer. The casual visitor to an observatory, enjoying a daytime telescopic view of the planet near the time of its greatest brightness, is likely to exclaim with delight at its brilliance, its whiteness, its crescent phase. If he is a little more sophisticated, he may notice the beautiful gradation of light between the limb and the terminator. The experienced planetary observer looks at the same view with something very like despair. The surface is white, smooth, and usually altogether featureless, except for the diminution in brightness resulting from the increasing obliquity of incidence of the Sun's rays.

Faint and fugitive markings have often been reported by visual observers. More contrast is shown on photographs made with ultra-violet light, as Ross showed in 1928, but, even then, the difference in brightness between the lightest and darkest spots is only about 25 percent. These markings change radically from one night to the next, and are obviously phenomena belonging to the planet's atmosphere, and not to a permanent surface.

When the planet is very nearly in line between us and the Sun, so that her apparent crescent is reduced to a mere hairline of light, a strange thing happens. We might expect this line to extend over a semi-circle, fading out to nothing at the ends; but, when the sky is clear, it has been seen many times to extend over more than a semicircle. This obviously could not happen on a bare spherical body like the Moon. It must be due to twilight—the illuminated atmosphere visible beyond the place where the sunlight grazes the surface itself. Indeed, when Venus is within a degree or so of the Sun—which happens rarely—she has been observed on several occasions as a luminous ring—the sunlit atmosphere being in sight all around the dark face.

From the amount of the extension of the horns, it is possible to calculate the height above the planet's surface to which the visible sunlit atmosphere extends; and this comes out only a little more than one mile. This is, however, not the full height of the atmosphere, but that of a hazy layer, which is so brightly lighted by the Sun's rays that it can be seen through the brilliantly illuminated foreground of our own atmosphere, close to the Sun.

When Venus can be observed on a dark sky, 20 degrees or so from the Sun, and yet appears as a narrow crescent, we might expect the twilight effects to be more extensive. Something of the sort was recorded by Schroeter, an enthusiastic observer at the end of the 18th Century; and his observations appear never to have been repeated with modern telescopes. Here is a nice problem for an amateur—provided that he has an instrument of considerable size with a field free from scattered light, and lives where the air is, at least sometimes, transparently clear.

THE reflecting power of the surface is high—about 50 percent. When allowance is made for the changing distance from the Earth, it is found that the diminution of brightness with phase, from full to half to crescent, is much smaller than for the Moon. This shows that the surface is relatively smooth. A study by Gerasimovic shows that these two things can be satisfactorily explained if the surface is covered by clouds or fog—consisting (like terrestrial clouds) of particles larger than the wavelength of light, but can not be accounted for by reflection from a solid surface or from a thick layer of cloudless gas.

The rotation period of Venus is still unknown, except that we are sure that it must be long. The markings change so much from night to night that they can not be followed; and observations for radial velocity, which alone suffice to reveal rotation for all the planets from Mars to Neptune, show here only that the motion is too slow to measure. It appears certain, however, that Venus does not keep the same side turned permanently toward the Sun. Radiometric measures at Mt. Wilson and Flagstaff show that the dark side of the planet radiates considerable heat; but, if it was always dark, it would be very cold. It is probable that the planet's "day" is several weeks long by our reckoning.

Evidence regarding the composition of the atmosphere can be obtained only with the spectroscope—and our powers of analysis are seriously restricted in the case of a cool body like this. We must observe through our own atmosphere—which cuts off all the ultra-violet except a beggarly part near the visible region. All the really strong absorption bands of the familiar gases lie in the inaccessible part of the spectrum. For a few of these there are feebly absorbed bands in the observable part of the spectrum, demanding many thousands of times more material to produce than the others, but for many of the best-known gases—for example, hydrogen, nitrogen, carbon monoxide, helium, neon, and argon—there is no accessible absorption at all, and we cannot detect them. The exceptions fortunately include just the constituents which are of the most general interest—oxygen, water vapor, and carbon dioxide.

The first two of these are present in our own atmosphere, and disturb observations of the planets seriously; but the difficulties, though troublesome, can be surmounted. Venus, with her great surface brightness, is the most favorable of all the planets for such a test. Yet the observations of St. John and Nicholson, at Mt. Wilson, failed to detect any observable absorption by either. For oxygen, the test is sensitive, and the observers conclude that the amount above the surface of Venus must be less than a thousandth part of that in our atmosphere. The test for water vapor is much less delicate, and an

amount much less than a tenth of that on Earth (above a mile-high mountain in dry weather) would have escaped detection.

Carbon dioxide, however, gives bands in the infra-red, discovered by Adams and Dunham, which, though not very strong, indicate that the amount of this gas above the planet's surface is equivalent to a layer about a mile thick, at standard temperature and pressure—about 400 times more than here.

On Earth, however, carbon dioxide is continually being removed from the air by the growth of plants, which use the carbon in building their own substance, and turn back the oxygen. On a lifeless world, we might expect to find far more carbon dioxide, and little or no oxygen; so that this is no puzzle. But the absence of water is hard to account for. The sunlit side of Venus must be hot, especially as the carbon dioxide in the atmosphere must serve as a very efficient heat trap; and it appears probable that the temperature of the planet's visible surface is not far below the boiling point of water, or higher. The solid surface below the visible clouds or haze must be still hotter. If there were oceans on Venus, or any considerable, though smaller, quantity of water, its evaporation would saturate the atmosphere with moisture, and cause the appearance of water-vapor absorptions in the spectrum, much stronger than those produced by the Earth's atmosphere.

Venus is so nearly a twin of the Earth in size and mass that it is very hard to understand how she could have practically no water, while our planet is almost drowned in it. No satisfactory explanation has yet been suggested; yet the train of evidence which has just been sketched is so strong that we appear, at present, to have to accept it as a fact.

But if there is no water on Venus —or practically none—what produces the great veil of whitish clouds which covers her whole visible surface? A very interesting suggestion has just been made by Wildt, pointing out possibilities which would never have been thought of by astronomers less familiar with chemistry.

Start with the assumption that the atmosphere of Venus, long ago, contained a great deal of carbon dioxide (it is still there), a small amount of water vapor (for the reasons just stated), and little or no oxygen. The temperature of the surface was, and is, high enough to make the appearance of life very improbable. The surface of the planet, if of composition like terrestrial rocks, would contain partially oxidized (ferrous) compounds of iron, and these, if there was any water present, would undergo weathering and exhaust

A photograph of Venus, made by Harold A. Lower, using a small telescope as a camera. Many are surprised, on their first view of Venus through telescope or opera glass, to discover that its disk is not round but shows phases, as does the Moon. Indeed, there are persons who claim they can even see the half-moon appearance of Venus with the unaided eye (the smallest glass renders the phases clearly visible). Perhaps the fact that such persons know what to look for to some extent influences this belief. Galileo was the first of record, however, to have seen them, using his first telescope. Copernicus had predicted them

from the atmosphere what little oxygen remained, leaving the carbon dioxide and water vapor.

These gases, when exposed to short-wave ultra-violet light, enter into the reaction

$$CO_2 + H_2O = CH_2O + O_2$$

forming formaldehyde and free oxygen. The considerable amount of energy required is furnished by the light.

Formaldehyde, while reactive chemically in many ways, is highly resistant to attack by oxygen. Hence it is possible that, while the oxygen is used up by further rock weathering, the atmosphere may contain steadily increasing quantities of formaldehyde gas. If so, Venus would be a very poor place for men in some hypothetical "space ship" to land; they would be poisoned at once.

But a test of this hypothesis is available. Formaldehyde exerts a very powerful absorption upon ultra-violet light, producing a system of bands extending up to λ3600 — that is, well into the spectral region which we can observe through our atmosphere. Dr. Wildt, during a recent stay at the McDonald Observatory, obtained a series of ultra-violet spectra of Venus, and of the Moon for comparison. Careful comparison of the two showed not the slightest difference in the spectra of the light reflected from the two bodies. If there had been an amount of formaldehyde in Venus' atmosphere enough to make a layer of the gas a quarter of an inch thick, under standard conditions, its absorption could have been observed.

One would think, then, that this theory must be abandoned; but here is where more chemistry comes in. Formaldehyde has unsaturated molecules, which have a strong tendency to link themselves up into long chains—indeed, this makes it an important raw material for the production of some commercial plastics. Even in the pure state, it condenses into a solid white mass—probably consisting of a complex mess of longer and shorter chains. Water-vapor catalyzes the reaction. If a small amount of it is injected into absolutely dry formaldehyde gas, the reaction vessel is instantly filled with a dense white cloud of finely divided solid particles. If heated hot enough these polymerized hydrates are dissociated into their constituents; but this requires a temperature of about 200 degrees Centigrade. At the temperature which probably prevails on Venus' surface, there would be little decomposition—which may account for the absence of the formaldehyde bands in the spectrum.

It seems, then, to be quite possible that the very absence of abundant water from the planet's surface—if in presence of abundant carbon dioxide—may lead to the production of white clouds on its atmosphere, and the precipitation of white polymeric compounds on its surface, and so account for its telescopic appearance.

Dr. Wildt presents this reasoning tentatively, as a possible explanation. It is very interesting to see how results obtained by chemists, with not the slightest thought of application outside their own science, and published in journals that not one astronomer in a hundred thinks of reading, may, years afterward, offer a clue to an outstanding astronomical puzzle. — *Princeton, October 2, 1940.*

Protecting Gasoline Tanks

Principles and Practice In Development of Bullet-Proof Tanks for Airplanes

ALEXANDER KLEMIN
Aviation Editor, Scientific American. In charge, Daniel Guggenheim School of Aeronautics, New York University.

WHEN the Army Air Corps announced a few months ago that it had secured a leak-proof or bullet-proof gasoline tank, old timers in aviation were astounded—because they had known and used protected tanks at least 15 years ago. Protection for tanks was news only to the younger personnel of the Air Corps. But if the protection of tanks is an old story, the scientific principles involved may not have been clearly understood hitherto. Accordingly, a paper by A. R. Weyl, in the *Journal of the Royal Aeronautical Society*, entitled "Fire Protection of Petrol Tanks," which does go thoroughly into principles, has been well received on both sides of the ocean. The Weyl paper is based on systematic research work with the aid of slow-motion cameras and other devices of modern ballistics.

Here are Mr. Weyl's general conclusions regarding tank design:

> The entry hole made by a bullet is harmless, and no ignition is connected with the entry. It is quite easy to seal the entry hole made by a bullet. The exit hole or leak made by a bullet which has passed through a tank is much larger and is much more difficult to seal. The motion of the bullet inside the gasoline produces pressure waves and it is the pressure waves which are the cause of the exit leak and help to produce ignition. If the bullet can be made to stop within the tank no ignition may be expected. If the bullet can be separated from the gasoline while inside the tank, the exit leak will be small. If the bullet can be freed from gasoline at the moment when it is leaving the tank, no ignition should take place. Incendiary bullets designed to disintegrate inside a gasoline tank are unlikely to cause ignition.

These general principles are of real value but Mr. Weyl goes beyond principles and gives some thoroughly practical design suggestions.

It is important to concentrate the gasoline of an airplane in one very compact tank. Then there is less surface for bullets to strike, and the weight of tank protection is smaller because the compact tank has so much less surface in relation to its volume.

What metal should be used? There does not appear much reason to choose one metal over another. Brass offers slightly higher resistance to the impact of pressure waves because of its elasticity. Magnesium tanks suffer large holes, but their edges are not deformed. On the whole, one metal will do almost as well as another.

To restrict the pressure waves, it is important to have baffle plates. How can the baffle plates be arranged inside the tank so that all likely hits are faced by them? A star-shaped arrangement of baffles seems adequate but heavy.

Since pressure waves cause the dangerous exit leak, the tank mounting is important. If the mounting is too soft, resonance is to be feared. But above all, the support of the tank must be well distributed; the internal pressure waves are then less likely to cause trouble. Further, the tank should not be mounted in brackets, but in a cradle or straps.

Is it any help to use hollow containers or compartments within the tank? That might be helpful, since the pressure waves could destroy the internal compartment without the outside walls being affected. Filling of the protective compartments with inert gases was found to be useless, however.

Here, in general, is the proper way to protect the tank: Around the metal there is fitted a gasoline-tight fabric, treated skin, or parchment. Then a fairly thick layer of sealing compound which swells under the action of gasoline and fills the entry and exit holes. Since the sealing compounds have no strength, a sealing bandage must come outside of all this in the form of highly elastic vulcanized rubber. The compressing rubber cover helps to separate the bullet from the gasoline in accordance with one of the principles given above. The whole structure should be enclosed in a wire net of a large mesh which is electrically connected with other metallic parts of the aircraft to prevent electrical ignition effects.

Of course, superimposed upon all these requirements, will be the final requirement that the protection of the tank must not be so heavy as to impair the general load-carrying capacity of the airplane. Otherwise military authorities might decide that it was better to have a lighter, more maneuverable airplane and to take a chance on the bullets piercing the tank.

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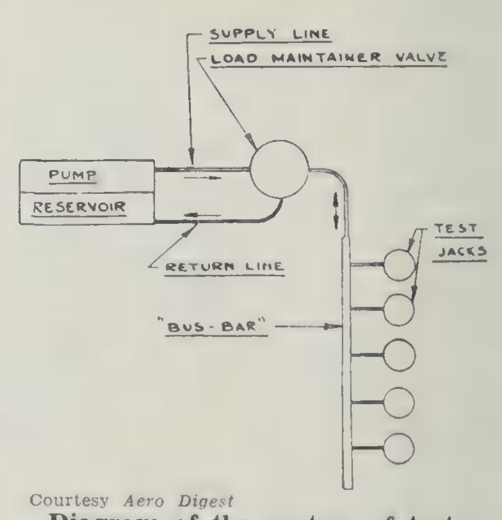
HYDRAULIC TESTING

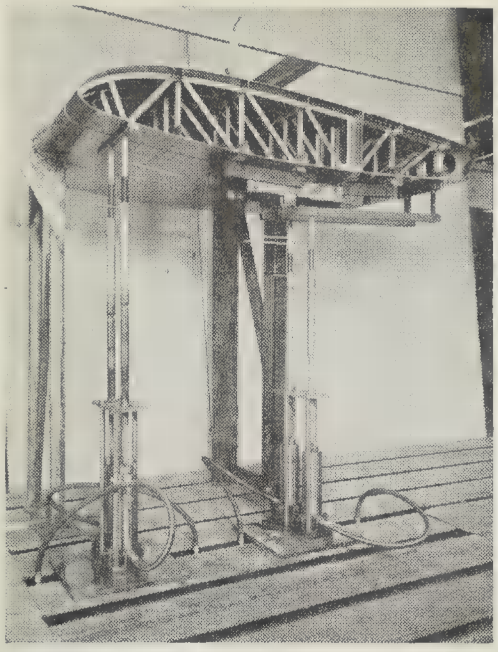
Destruction of Airplane Parts Reveals Defects

TESTING to destruction of the structure of airplanes dates well back in aviation; during the World War the Army Air Service, with the aid of French and British missions, converted into an art what used to be a crude shop test. Today, the structural testing of wings and fuselages is as useful as ever, and methods are highly refined.

Charles Tilgner, now Chief Aerodynamicist of Grumman Aircraft, has been responsible for great progress in "hydraulic testing." Loading sandbags or shot-bags weighing thousands of pounds on the wing is a painful, slow process, which may be dangerous when the structure suddenly lets go and



Courtesy *Aero Digest*
Diagram of the system of testing airplane parts hydraulically



Using hydraulic jacks to test the structure of a plane wing

heavy bags fly downward. Another drawback of the sand-bag or shot-bag is that if loads are not applied simultaneously, secondary stresses and inaccuracies may be introduced. Mr. Tilgner has developed a method which avoids all these drawbacks; loads are applied to the wing by suitably placed hydraulic jacks. The loads from some of the jacks are also applied through a leverage system, so that a single jack applies a predetermined load to various parts of the wing. The jacks are all connected to a single source of supply, as shown in the diagram, and between the pump and the jacks there is introduced a load-maintaining valve in which a weight on top of a piston is used to provide a constant pressure. With pump and valve under complete control, and a single source of pressure supply, the engineer can be quite certain that he is applying exactly the required load to each part of the structure. Further, the load can be applied and released with rapidity and ease.—*A. K.*

AIR TRAILERS

Possibility of Transporting Troops by Air

A CORRESPONDENT asks whether the idea that Germans will tow gliders behind airplanes to transport troops has any merit. In spite of all the discussion by "experts," no definite answer can be given. W. S. Shackleton, writing in *The Aeroplane*, gives as good an analysis of the problems involved as anyone. He believes that such a troop train will be practicable. This would consist of four large gliders, each about 82 feet in span and each carrying 20 troops, spaced 100 yards apart and towed behind a large twin-engined transport.

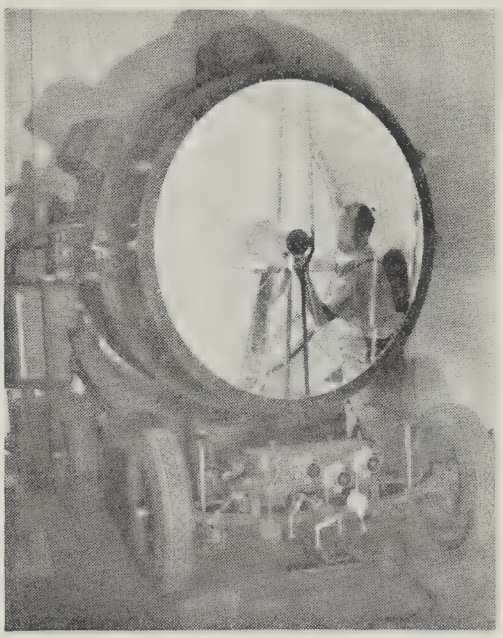
There are many difficulties, however. The glider train would be slow and vulnerable. It could not possibly defend itself with gun fire, and it certainly could not maneuver or conduct a dog fight in the sky. There is also some doubt as to what would happen to the glider train in rough weather.

We suggest a glider trailer flight as a spectacular feature for the next Soaring Meet at Elmira.—*A. K.*

SEARCHLIGHTS

IMMENSELY powerful anti-aircraft searchlights of the type being used by the British in defending London are being delivered to the United States Army by General Electric. Naturally, information is restricted, but we are free to say that the lights are 60 inches in diameter and of 800,000,000 candle-power. They are effective for at least 5½ miles in the air, which should be sufficient for spotting most bomber attacks.

The searchlight is not new in principle, since a powerful arc with



800,000,000 candle-power

concentrating mirrors has been customary for decades, but besides the extraordinary power of the new lights it has many valuable features. Thus, the beam may be directed from side to side or tilted up or down just as easily as a motor-car can be steered. Both the lights and the power plants which accompany them are mounted on rubber-tired wheels for easy towing into position or for transporta-

An airplane finder used in conjunction with powerful lights

tion in trucks. The searchlights are, of course, used with an optical airplane finder. Our photographs illustrate several aspects of these lights. Even though the best anti-aircraft defense lies with interceptors or pursuits, good batteries, well directed, make life very unpleasant for the enemy bombers; these lights should be most valuable in our national defense.—*A. K.*

OXYGEN BOOST

Increases Diesel Power for Take-Off

AIRPLANES require about one third more power in take-off than in flight, and airplane gasoline engines fortunately have higher rating at take-off than in normal operation. Against the airplane Diesel engine there has been raised the objection that its power cannot be boosted during take-off.

Professor P. H. Schweitzer, of Pennsylvania State College, writing in *Mechanical Engineering*, describes experiments intended to remove this criticism. He has tried to increase the power for short intervals by feeding pure oxygen to the cylinder and increasing the oxygen concentration from the normal 21 percent to 45 percent. So much extra power can be developed for take-off by this method that the size of the airplane Diesel could be reduced some 25 percent by the "boost." While the oxygen containers are heavy, they are not heavy enough to invalidate the possibilities of the system. Now that the laboratory experiments have proved satisfactory, it would be desirable to make an actual test in flight operation.—*A. K.*

Lightless Light

Black Light—Unseen Rays—Causes Many Materials to Glow, Has Practical Uses

PHILIP H. SMITH

IMAGINE a convoy of ammunition trucks speeding along a highway in pitch darkness, holding to the center of the road and following its contours with unerring accuracy, but using no headlamps. This isn't a Jules Verne dream. It is a possibility, thanks to black light.

If you don't care for the warlike, you can choose a peacetime scene. Imagine a motion-picture theater having its lobby illuminated entirely by the soft light of glowing walls and luminous statuettes. If you arrive late and the house is dark it is simple to find your seat because a luminous design in the carpet guides you down the aisle, and the seat number sparkles in the dark. This, too, is a possibility, and again, it is a black light phenomenon.

The paradoxical name "black light" is given to rays or certain wave bands in the ultra-violet end of the spectrum. Roughly speaking, these waves have lengths ranging from 3300 to 4000 angstroms (light measure), 4000 being the beginning of visible light. These invisible rays have the ability to make certain materials fluoresce, or glow, as though they were producing light. They don't tan skin or have germicidal properties as one might expect of ultra-violet rays, these properties being possessed by waves of shorter length. Fluorescence occurs only in the presence of the rays. It is unlike phosphorescence whereby light is stored and given forth after the light source is removed.

Black light is no recent discovery, but it has been used indifferently. Luminous costumes have been featured on the stage from time to time. Europeans, particularly the Dutch, have developed it to practical ends much more than we have and now the commonplace of blackouts has given it a great boost. Today we have available inexpensive black-light sources and a wide color range of paints, dyes, and inks which have been rendered durable through painstaking research.

There are three types of black-light lamps. The simplest type, suitable for amateur work, is a tungsten filament lamp with a black glass bulb. Its life is short because of the high temperatures required for ultra-violet radiation. The other types are high-intensity, mercury vapor lamps, one employing a black glass bulb; the other, a clear glass bulb with separate black glass filter. This last mentioned type is the most practical and widely used commercially, because the filter does not have to be replaced if the bulb goes. Mercury is used because its spectrum contains the richest emission of ultra-violet rays in the black-light zone.

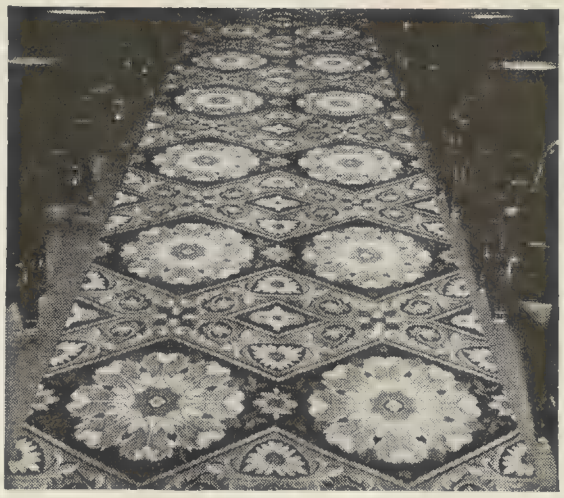
Look directly at a black-ray lamp and if you see anything it is a core glowing like the heating element of an electric toaster. You will notice that a haze comes before your eyes which is annoying but not dangerous. This sensation is caused by a slight fluorescing of the eyeball. If someone should look at you while you are standing in the rays, they would see your teeth glowing in the dark, provided they are your own teeth. Store teeth will not fluoresce. Your fingernails also glow, otherwise you would be practically invisible.

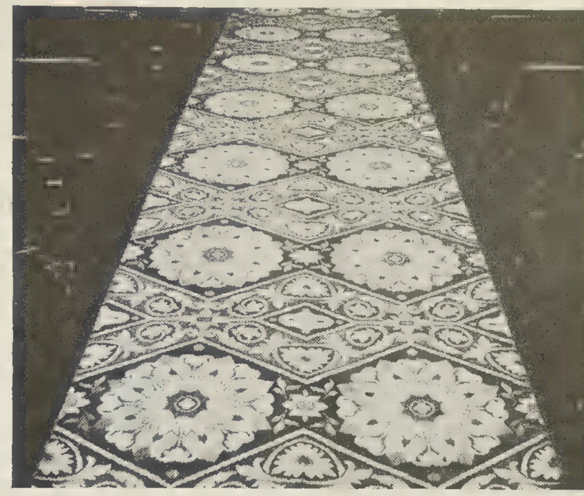
The materials used to make fluorescing paints, dyes, and inks, are more or less trade secrets. There are plenty of substances which fluoresce naturally but it has taken years of experimentation to select them for proper color and durability. Today, there is a fair range of colors to be had, and in Europe they go so far as to offer fluorescing materials in the form of plastics, make-up, chalk, and crayons.

MOST visitors at the New York World's Fair were unaware that they saw a sort of dress rehearsal of black light. The night scene in the Perisphere's miniature city was created by coating windows with a fluorescent paint and turning on black light as the ordinary light was turned off. The luminous bathing caps of the swimmers in Billy Rose's Aquacade were simply colored with fluorescent materials so that they would glow in the rays

A possibility for fashion shows: An evening dress and wig under ordinary light and black light. The latter causes the dyed design to glow in colors

At right: **A carpet in a theater aisle as it appears when lights are on, and glowing under invisible ultra-violet rays.** *Below:* **In complete darkness, steps in another aisle are easily seen as black light makes the dyes of the carpet glow**





of concealed lamps. Both these spectacles demonstrated the possibilities for achieving dramatic light and color effects.

Fluorescent wall paints are now in commercial use. Common practice is to paint walls in designs which will look well under all lighting, but glow luminously in desired color combinations under black light and give sufficient light for seeing. It is particularly well suited for the soft lighting of cocktail bars and lobbies. There are paints which show only in daylight; others which respond to both daylight and black light, and a third type which has color only under black light. By a judicious use of these three types in combination, some striking effects can be produced. You'll soon see advertising displays which have a dual aspect created by the alternate flashing of ordinary light and black light. For the time being these will be used indoors or sheltered from direct sunlight because the fluorescent properties are impaired by the sun's rays.

As luck would have it, many inexpensive dyes are fluorescent. A ten cent handkerchief is very likely to become a thing of rarest beauty in the rays of black light. Dyed fabrics can be used for stage curtains and costumes and now there are carpets woven from materials given fluorescence with dyes. One wonders what the effect will be upon theater audiences if black light becomes common. Fluorescent carpets already are used in 25 theaters. Must the theater-goer of the future consider dressing for two lighting effects?

This is a fair question, because the practice of marking fine fabrics with invisible fluorescent inks is being carried on by some laundries and cleaners, and as a result Mrs. Jones is known to have been de-coded as she walked down a theater aisle—late to the performance. If this simple scheme to avoid ugly laundry marks leads to trouble, more can happen. We know that some rouges go dead black under the rays; we have yet to find out about hair dyes.

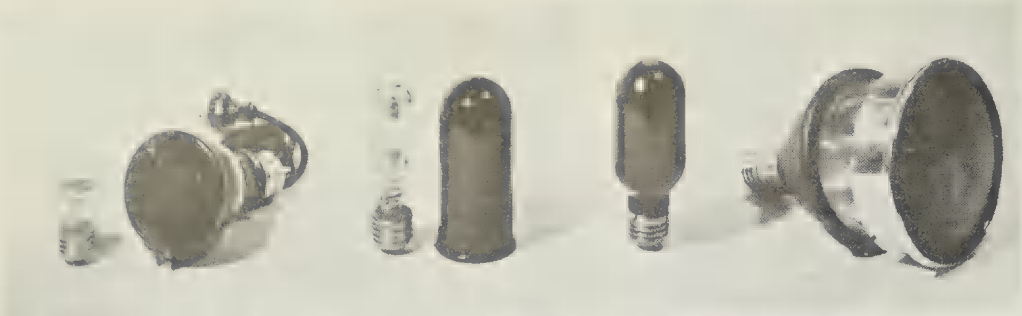
Circulars printed with fluorescent inks are being used to show prospects the possibilities of lighting equipment for advertising purposes. We see a building pictured under ordinary light and that's the daytime appearance; then, by switching on black light, the circular shows signs and building walls glowing with the effect of night reality. It is conceivable that books and magazines will be printed in such inks for those whose eyesight can be helped by illuminated lettering.

Black light has moved into the field of fraud detection. It can be used to reveal alteration of documents either by showing the work of ink eradicators or differences in inks. Still in its infancy is the detection of frauds in antiques. Suppose, for example, you possess a pair of glass candlesticks with dangling prisms. If the two are not contemporary or some of the prisms have been lost and replaced, the substitution is easily detected. Glass is fluorescent—particularly cheap, modern glass which contains uranium salts—and glass from different sections of the country and of different manufacturing eras, rarely if ever fluoresce with identical color.

OLD tapestries and fabrics lend themselves to black-light check. If there has been mending it will be revealed, because old and modern dyes are readily distinguished in black light. Even furniture can be examined for antiquity because old-fashioned glues fluoresce quite differently from modern ones.

Sam Hibben, one of the fathers of black light, tells of purchasing a sandstone fossil of a crustacean while traveling as a boy in Austria, and of proving its genuineness with black light many years after. The fossil came under the rays quite by accident and to his surprise it glowed brilliantly. The explanation is not hard to find. Fluorescence had not diminished with age and this crustacean displayed it just as do the skin and bones of fish.

Before black light becomes a reliable tool for testing antiques, standards will have to be established. Your candlesticks, for example, may not be a matched pair, but which is new, which is old—which is the fake and which the genuine? Perhaps both are genuine, differing only as to place and



Several types of black light lamps. Two, of clear glass, stand beside reflector and hood of black glass. A self-contained lamp, at right of center

time of manufacture. Repairs to glass, furniture, and fabrics can be ascertained, but experts will have to struggle long before they are able to place an object definitely within a given period.

In Holland, black light is used for sorting diamonds. It reveals source of origin rather than quality. Some diamonds fluoresce brightly, others only very little. If you should examine a bracelet of diamonds under black light you would find few of the gems glowing alike. Some other odd but practical uses to which the Europeans have put black light are to ascertain adulterations and food quality. Butter can be distinguished from margarine because the former fluoresces yellow, the latter pale mauve; fresh eggs fluoresce red while stale ones are brown.

There is a very broad field in mineralogy. One can distinguish many minerals in mines under black light, and companies are already using it to search out zinc and tungsten deposits— to find the richest ores and to examine scrap piles for valuable minerals discarded in error. By pure chance, most of the really valuable minerals and metals fluoresce. It is possible to distinguish genuine sapphires, pearls, and ivory from the artificial, to tell new cut jade from old, and to spot rubies from Siam as contrasted with those from Burma or the synthetics.

A VERY simple application of black light has recently been placed on the market. It calls for coating reflectors with a substance which fluoresces red, and when used in combination with mercury lamps, a pink tint is added to make up partially for the red-ray deficiency characteristic of the mercury spectrum. Even more ingenious is the weaving of a fluorescent strand into rope, as now practiced by one manufacturer. This simple trick makes possible checking up rope which fails in use to see whose product is at fault—the ingenious manufacturer's or a competitor's.

Experimenters have been trying a variety of stunts to test out black-light possibilities. One of the most novel has been to play cards with no illumination other than that furnished by a tablecloth of fluorescent dyed fabric and cards printed in fluorescent inks. It is significant only in demonstrating how objects themselves can be made a source of light—an idea very likely to be capitalized upon. Now that fluorescent substances can be incorporated in plastics, the idea gets a real boost. The plastics can be formed into figurines and statuettes, into artificial flowers, and into threads for weaving into fabrics, and all these supply what might be termed artistic, indirect lighting fixtures, though the light is only a glow.

Of military uses for black light, little can be said because nothing is known officially. But one can hardly mull over the great advantage of invisible light under wartime conditions without having some uses come to mind. The convoy described at the beginning of this article finds its way by flashing black light on fluorescent painted markers lining the roadway, and that's just one step ahead of the present practice of using prismatic buttons. Gages and controls of artillery and aircraft can be illuminated in such a manner as to be invisible to the enemy. And perhaps this is being done. The Germans must know plenty about black light because they control the Netherlands, the seat of black-light development.

Both fluorescence and phosphorescence are being used in England. The London bobbies have crossed suspenders which show up in the darkness of blackout traffic. The entrances to air raid shelters are indicated by fluorescent mark-

"Democracity" in the Perisphere at the New York World's Fair. The effect above at left was achieved wholly by use of fluorescent paints on the city and black lights overhead, not a single inch of wiring being in the city itself. Above, at right, the tiny city and surrounding country under ordinary light

ings, or with phosphorescent paint.

Black light sounds like the light the little man who wasn't there reads by, but for all its paradoxical nature it has a valuable role to play in the future. First and foremost, it affords an opportunity to achieve color and light effects by illumination which cannot be obtained by any other means. In time, decorators may have to think in terms of two lighting effects. It already serves industry, but here the possibilities have no more than been scratched. The lamps and fluorescent materials are available and practical and it remains only for man's ingenuity to put them to varied esthetic and commercial uses.

Photographs courtesy of Calco Chemical Co.; Alexander Smith & Sons Carpet Co.; Stroblite Co.; Westinghouse Elec. & Mfg. Co.

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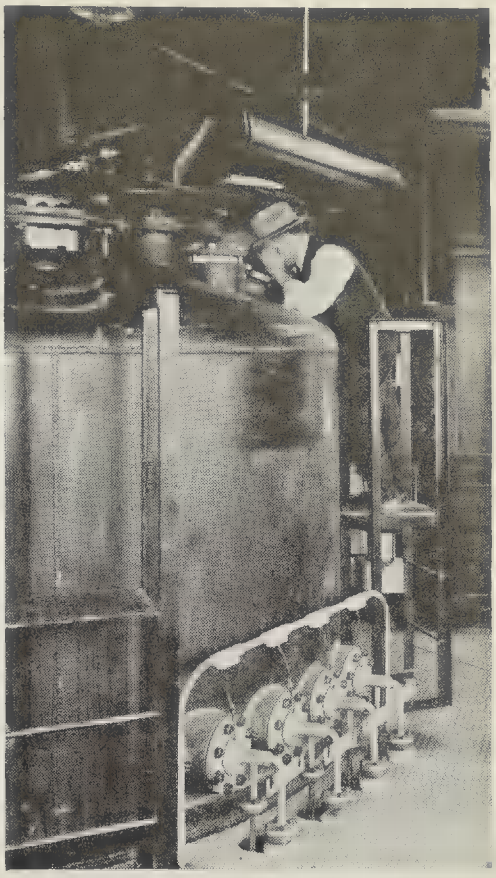
Carbolic From Gases

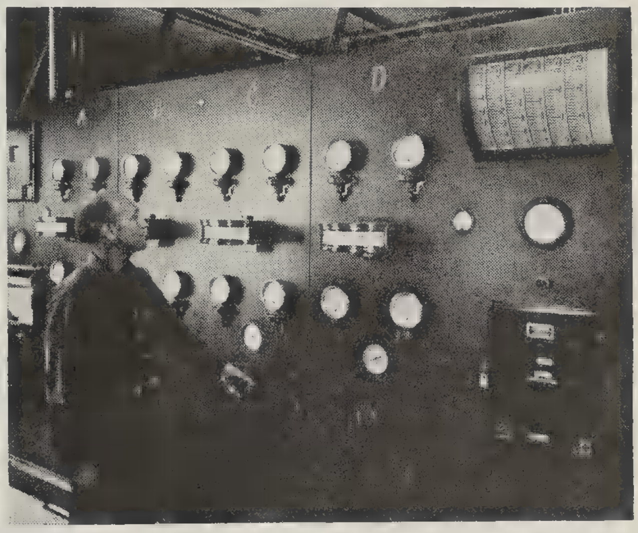
World's Largest Synthetic Phenol Plant Is Operated By Only Six Men



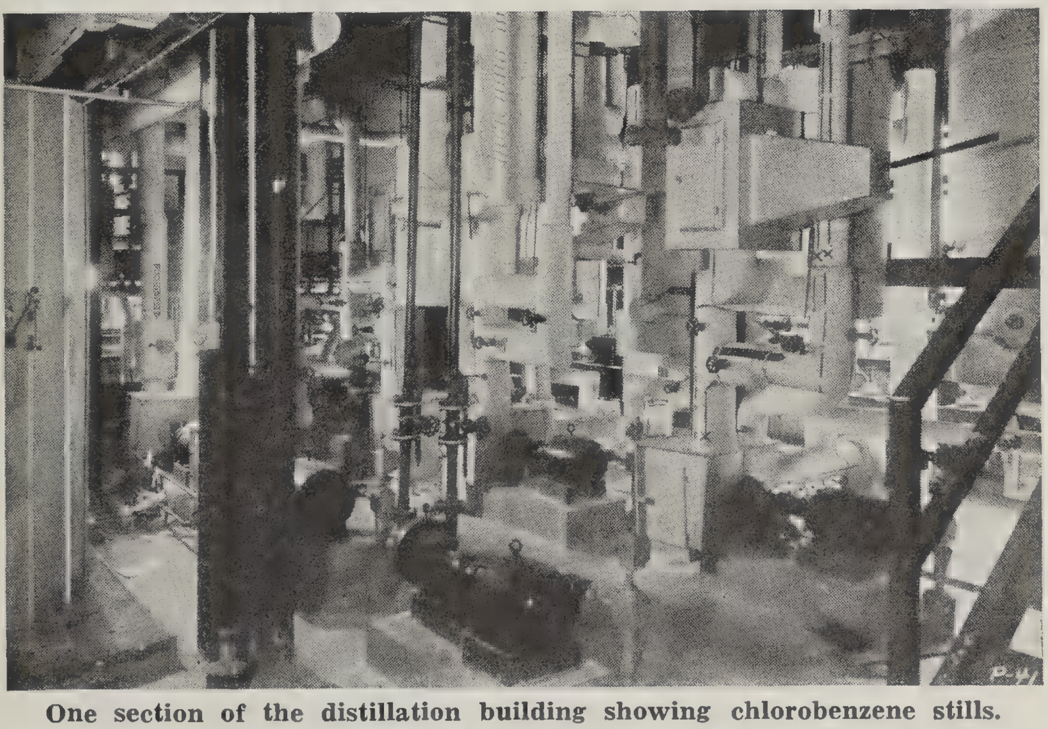
Peep holes enable operators to observe first stage of process

MANY plastics employ phenol, better known to the layman as carbolic acid, as one important constituent. Since the year 1834, phenol has been made from coal, an enormous amount of by-product being produced for every pound of phenol. The plastics industry has grown so fast, however—from a production of 2,000,000 pounds in 1921 to more than 200,000,000 pounds in 1939—that it has become necessary to synthesize the basic materials used in their manufacture.

Of great interest, therefore, is the new $2,000,000 plant built at North Tonawanda, New York, by Durez Plastics & Chemicals, Inc., for the production of synthetic phenol from several common chemicals. When the acid is made by the new Raschig process, the by-products amount to less than one-tenth of a pound for each pound of phenol. The plant, the largest of its kind in the world and the only one in the United States, is one of the most amazing chemical units in the world. In spite of its size and the intricate processes involved, it can be operated at full capacity by a force of six men and a supervisor for each shift. Operations are controlled automatically by these men at master control panels. In case of motor trouble anywhere, automatic signal divisions warn the operators who can then cut in duplicate equipment from their control stations.



Vapor superheater temperatures are controlled at this station



One section of the distillation building showing chlorobenzene stills. Duplicate pumps assure continuous operation regardless of breakdowns

There are several large buildings, towers, and distillation units, all joined with 40 lines of pipe, three miles of which is made of glass, porcelain, or rubber, to withstand the action of acids at high temperatures. Duplicate equipment has been installed at every stage for use in case of trouble.

The process itself is so intricate that many leading chemical engineers in this country refused to consider it when it was first offered here a few years ago. Briefly, it consists, first, in passing a vapor mixture of benzene, hydrochloric acid, and air through a catalyst. This produces a mixture of chlorinated benzenes from which mono-

Portion of the intricate glass pipe manifold on top of the acid recovery tower. Here the Raschig carbolic acid process starts in the second stage

chlor-benzene is distilled in the pure state for use in the second step. In the second step, a vapor mixture of mono-chlor-benzene and steam is passed through a catalyst which produces phenol and regenerates the hydrochloric acid. These two stages actually form a completely continuous process, and during the process most of the materials formed, and the catalysts, are recovered for re-use. The process can be likened to a game of ring-around-a-rosie, the process making a continuous circle with the phenol being extracted or drawn off as it is formed, and new materials and new catalysts added as the original ones wear out or become used up.

Assuring an independent and controlled source of the purest phenol obtainable in this country (above U. S. P. standards) this new plant not only makes possible improved plastics but also is a definite aid in national defense, for phenol is used in some explosives.

• • •

NATURAL GAS STORAGE

Changed To Liquid, Stored in Smaller Tanks

THE dream of J. A. Clark and R. W. Miller, of Pittsburgh, engineers of the Hope Natural Gas Company, of reducing natural gas to the liquid state and then storing it at 250 degrees below zero, has come true in a new plant now being erected at Cleveland for The East Ohio Gas Company. The tanks holding the liquid gas are of special nickel steel and are insulated by walls of cork three feet thick.

Even metals lose their strength at sub-Arctic temperatures. The problem of storing liquid natural gas, therefore, involved research and experiment to find materials which would withstand the harrowing cold of the liquefied fuel.

The reason for this interest in liquid natural gas is not hard to find because natural gas companies have experienced considerable difficulty in solving the problem of varying gas demands by consumers. Generally, the natural gas supply and the consuming center are miles apart, joined by a pipe line. Economic reasons dictate the size of such lines, and they are used only at part of their capacity in the summer time, at best.

Sometimes gas companies solve their storage problem by raising the pressure of gas in the pipe line, making this a natural storage reservoir, but it is a limited one. Other companies have used high-pressure storage tanks, but these are expensive and rather uneconomical ways of storing large volumes of gas.

One cubic foot of liquid natural gas would make 600 cubic feet of ordinary natural gas if allowed to return to its natural state, and all of this would take place without any change in the gas. Thus, a big gas holder can store 15,000,000 cubic feet of gas but it would take a holder of only 25,000 cubic feet capacity to store the same amount of gas in the liquid state. This saving in storage space had such great appeal that Mr. Clark and Mr. Miller began extensive experiments as far back as August, 1937, to solve the many problems of economically liquefying and storing natural gas.

These experiments revealed that the most practical method of liquefying the gas was by the so-called "cascade" system in which the gas is cooled to the liquefying temperature by passing it through four stages, each one of which is surrounded by a closed circuit containing liquids having successively lower and lower boiling points.

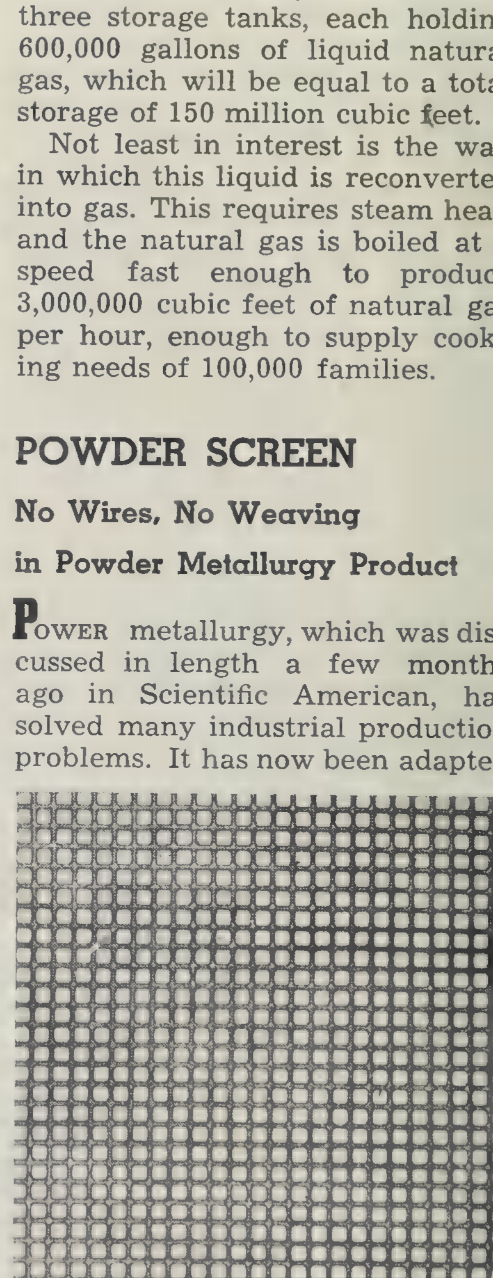
The Cleveland plant will be able to liquefy 4,000,000 cubic feet of natural gas each day and will have three storage tanks, each holding 600,000 gallons of liquid natural gas, which will be equal to a total storage of 150 million cubic feet.

Not least in interest is the way in which this liquid is reconverted into gas. This requires steam heat, and the natural gas is boiled at a speed fast enough to produce 3,000,000 cubic feet of natural gas per hour, enough to supply cooking needs of 100,000 families.

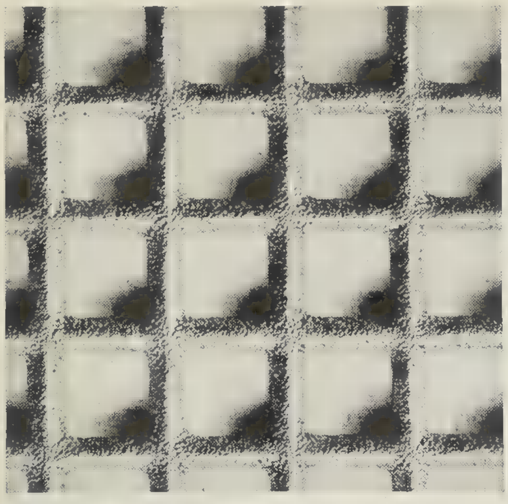
POWDER SCREEN

No Wires, No Weaving in Powder Metallurgy Product

POWER metallurgy, which was discussed in length a few months ago in Scientific American, has solved many industrial production problems. It has now been adapted



Powder screen, natural size



Powder screen, 6x

by the Chrysler Corporation to the production of fine bronze screens. The resulting screen, shown in the accompanying illustrations, is, as yet, only a laboratory curiosity. It is, however, practical from the standpoint of both use and manufacture.

This screen was made of finely powdered copper and tin, processed and molded into finished form without the necessity of first making wire and then weaving it into the required pattern.

ANOTHER SYNTHETIC

"Rubber" Made From Waste Gases

By making it as a chain of molecules to which only a very limited number of additional links can be added, American chemists have been able to produce from oil refinery gases, formerly wasted, a synthetic rubber-like substance with many advantages over imported natural rubber.

Dr. Per K. Frolich, director of the chemical division of the Esso Laboratories, recently gave the first technical report of the new "butyl rubber," developed by Standard Oil chemists. It is colorless, odorless, tasteless, and more stretchable than rubber from trees. —*Science Service.*

COLD-SET GLUE

Easy to Use, Water-Proof, Strong

What is said to be the first cold-setting resin adhesive ever produced in the United States has been announced by the United States Plywood Corporation. Called Weldwood plastic resin waterproof glue, the product is bacteria-proof, rot-proof, stain-free, and economical, as well as water-proof and enduring. It is made under Plaskon patents.

The new glue can be used by professional or amateur. It comes as a finely divided powder which dissolves instantly in cold water and is ready to use immediately after mixing. Jobs can be handled within two hours after gluing and can be worked after four hours. Since it sets by chemical action instead of evaporation, continuous submersion of the glued part results in no deterioration. It dissolves only in the presence of alkalis or acids that are strong enough to eat away the wood itself, or under heat above 160 degrees, Fahrenheit.

The manufacturers claim great economy in the use of this glue, as

Rock maple, joined with cold-set glue, broke; the joint held

they advise the thinnest possible coat on the surface to be joined, the coating being applied by a spray or by a brush and then squeegeed. Because of the small quantity of water used, shrinkage of dowels or close joints is minimized.

SMOKE ROUTER

Reduces Air Pollution By Smoke Stacks

A queer device that bombards smoke with high-frequency sound waves, thereby causing the smoke to lie down and play dead, is being developed by the United States Bureau of Mines. The idea is to attach one of these units to every chimney and stack, and prevent the smoke from getting out and spreading around the countryside.

Inside a piece of pipe is an aluminum cylinder which is connected at one end to a loud speaker and special radio set. The radio sets up a magnetic field which causes the aluminum cylinder to vibrate, producing powerful high frequency waves. These waves are directed at the smoke and cause the particles in the smoke to coagulate into relatively large pieces of soot which fall out of the air stream by gravity.

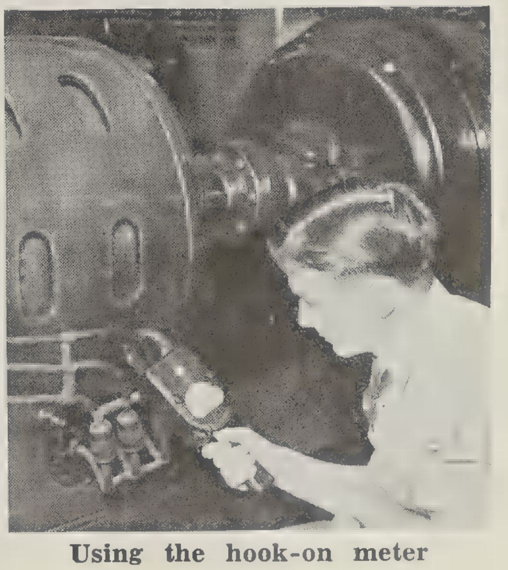
It's still an experiment, but has possibilities of doing much to reduce air pollution by smoke, if it can be applied to large-scale service.—*Aluminum News-Letter.*

HOOK-ON METER

Volt-Ammeter Snaps Over Wire

A versatile, portable instrument, a hook-on volt-ammeter for measuring alternating current and voltage, has been introduced by the General Electric Company. With it, alternating current can be read instantaneously on both insulated and non-insulated conductors simply by hooking the instrument around the line. For voltage readings, it is necessary only to connect two leads furnished with the instrument and then flip the thumb-manipulated selector switch to the desired voltage position on the scale.

Designed for use on conductors of 2-inch maximum diameter, the new volt-ammeter is small enough to get into tight places, light enough to be hung from a lineman's belt, and sufficiently accurate for a great variety of measuring jobs. Weighing only 3½ pounds, it is designed for easy, one-hand operation. Four current



Using the hook-on meter

ranges—0-15/60/150/600 amperes—and two voltage ranges—0-150/600 volts—are available at the setting of a convenient six-position snap switch. Its accuracy is within 3 percent.

An integral part of the instrument is a C-shaped, split-core current transformer so designed that it can be operated without a trigger. To make measurements, the transformer is simply pulled open and placed against the conductor.

A slight push on the handle snaps the transformer shut. The measurement completed, a gentle pull springs open the dovetail joint of the transformer and releases the conductor. The dovetail joint assures that particles of dirt, which would cause large errors in the ordinary butt joint, have almost negligible effects on the indication.

CIRCUIT BREAKER

Small, But Does A Big Job

A SIX-OUNCE electric "safety valve" was recently announced by Westinghouse. Not only does this hard-boiled midget switch stop a force equivalent to 230 horsepower, but it does it in a way that is entirely new. Representing an adaptation of principles involved in the design of a superior type of circuit breaker for airplanes, this device is intended to guard the lighting and appliance circuits of homes and industry.

Although it is not much larger than a woman's compact, the device is able to interrupt a short-circuit current as great as 5000 amperes, shutting off the flow of electricity through it in less than one sixtieth of a second.

Midget circuit breakers and woman's compact; compare sizes

Paradoxically, this unique circuit breaker permits the passage of momentary "overloads" of electric current, which normally occur when motor-driven appliances are started; but it also operates instantly to shut off the current if the overloads become dangerous.

This dual personality is due to the use of both heat and magnetism to operate the breaker. When lights or appliances are switched on, the flow of current through the contacts of the breaker gradually heats a bimetallic strip inside the unit. Since one of the metals in the strip expands faster than the other, the unit eventually bends, releases a latch, and breaks the circuit.

The bimetallic strip has been designed to permit a safe amount of "overload" to pass through it before opening the breaker. However, if the current increases beyond a safe margin, it not only causes the bimetal unit to trip but causes a magnet to help release the spring-latch and open the breaker instantly. In less than a sixtieth of a second, the electric arc is drawn through a half-inch gap between three tiny steel plates, cut into four smaller arcs, and quenched in air.

MIRACLE MEASURE

Finds Thickness of Paint To Hundred-Thousandth of Inch

MEASUREMENTS to less than one-hundred thousandth of an inch can now be made of the thickness of non-magnetic films such as paint, paper, and even rust or weathering on sheets of iron, reports the *Telephone News Bulletin*. It is done without disturbing the coating.

A short iron rod with two coils of wire on it is pressed, end on, against each side of the coated iron sheet. Both rods are magnetized by passing an alternating current through one of the coils on each rod. This induces voltage in the other two coils. The coating, which is non-magnetic, decreases the voltage on its side of the sheet by an amount which depends on the thickness of the coating.

This method, developed recently by the Bell Telephone Laboratories in New York, has many uses in the telephone industry, where tests of the condition and wear of a vast amount of indoor and outdoor equipment are being made constantly to improve the service.

BUBBLE DANCE

In Oil Circuit Breaker Aids in Design

MOVING pictures have revealed to engineers of the Westinghouse Research Laboratories a "bubble dance" of elusive electric arcs. Drs. Joseph Slepian and Thomas E. Browne, Jr., were seeking ways to improve the design of oil circuit breakers and discovered that the gas bubble, formed by decomposition of the oil surrounding the contacts, appears to dance as it oscillates from large to small size several hundred times a second. The pictures indicate, according to Dr. Slepian, that the quenching of an arc in one of these switching devices takes place entirely within a bubble of gas the size of a teacup or smaller.

With this equipment engineers searched for data on circuit breakers, found bubble dance

This discovery of the "bubble dance" is significant for it gives the engineers a suggestion as to the direction the design of oil circuit breakers should take. Indeed, Dr. Slepian believes that emphasis should be placed on the de-ionizing (removing of electrification) of the gas within the bubbles.

To carry out the advanced studies necessary in this research, Dr. Browne built an experimental circuit breaker with thick plate glass windows opposite the point where the contacts separate. Using a high-speed movie camera which carried the film forward at a speed of 50 feet a second, he used a revolving glass prism to move the image at the same speed. The prism acted as a shutter, revolving 60,000 times a minute, or about 30 times the speed of an airplane propeller during normal flight.

INDUSTRIAL TRENDS

INDIUM

ONE of the metals about which you have heard little but which is destined to play an increasingly important role in industry is indium. Broadly speaking it does for non-ferrous metals what chrome does for ferrous ones. It is attractive at this very moment because it has been proved that a very small amount added to bearings composed of alloys of cadmium, silver, tin, or lead, inhibits corrosion due to the organic acids present in the lubricating oils. Indium can be made to diffuse through these bearing alloys by simply coating them and heat treating, and there is no ill effect upon the bond between the alloy and the steel backing. Given the severe conditions under which the modern automobile and aircraft engine operates, indium makes a real contribution and it is no wonder that it has been seized upon to do its bit.

The earliest use of indium was to improve the quality of gold alloy castings in dental work. Another use is to lower the melting point of alloys. There are indications that casting alloys can be developed which will soften in hot water, thereby giving the medical profession something for molds. The metal added to tin seems to inhibit the phenomenon of "tin pest."

Like many of the other lesser known metals—beryllium, tantalum, molybdenum—indium was extremely costly at the outset of its use. From $300 an ounce, it has dropped to $30 for the electrolytically pure and $15 for other grades. Since a pinch of it goes a long way to produce valuable results it cannot be called a prohibitively priced metal. Furthermore, there's plenty of it in the country.

MORE MILES PER GALLON

There's an added significance given to work to improve bearings when one hears what the engine and fuel people plan for the future. Not content to have improved these two factors in transportation to an extraordinary degree, they want to jump farther. T. A. Boyd, of General Motors, declares that the use of a 100-octane number gasoline instead of 70 in experimentation has given a 55 percent increase in miles per gallon at 20 miles per hour and more than 40 percent increase at higher speeds. He points out that with an absolutely knock-free fuel one can get double the power or nearly double the mileage, but not both at once. Thus far the public has demanded the added power, but in the future it may favor greater economy and that would bring about smaller displacement engines than those in use today.

There hasn't been much said about a motor fuel famine in late years for the very patent reason that research has made possible extraction of double the amount of gasoline from the crude oil and thus upset all the sound calculations of those who "viewed with alarm." Given fuels that will deliver the power and engines that will take it, focus attention on the merit of economy now that excellent performance is commonplace, and the net result would be more inexpensive motoring and a conservation of our petroleum resources to postpone still further the day when motor fuel must be obtained from other sources.

TRANSPARENT FILM

Ethylcellulose cast in brilliantly clear transparent film is coming into commercial prominence for modern packaging. Under the trade name of Ethofoil, it is getting into large-scale production now that users have given it an extensive tryout.

The properties which recommend this newer among the packaging materials are many. It is easily fabricated by light or deep drawing, much in the manner of metals, to make objects which have definite form while retaining their flexibility under long aging and high temperatures. It can be produced in opaque, translucent, or transparent colors; it can be sealed with adhesives, stapled, or rivetted; and it is readily printed. Ethofoil is not flammable but will burn with a slow flame. It is not affected by alkalis and is resistant to dilute acids. It transmits about 90 percent of visible light and a large proportion of ultra violet. The rays absorbed by window glass pass through the foil.

MORE NYLON

There's no gainsaying that nylon is a "natural" in the commercial world. With the announcement of the building of a new plant to raise the aggregate production to 16,000,000 pounds, Du Pont declares that this total is five times what was contemplated when the first plant was authorized in 1938. It is a snowball rolling up to huge proportions and it is a safe guess that world conditions are giving some of the shove.

The United States takes about 78 percent of Japan's silk output. If we take last year's consumption of 50,000,000 pounds, we see that nylon will be ready to fill one third of silk requirements by 1942, and that will mean a beating of all records—even those made by the fast growth of Cellophane.

ADMIRALTY METAL

Adding a small amount of antimony to the formula for the well-known admiralty metal gives a product which resists dezincification, sulfur corrosion, and inter-crystalline corrosion.

Antimonial admiralty is particularly suited for heat exchangers, condenser and evaporator tubes, offering as it does resistance to corrosive water conditions as well as sulfur corrosive conditions. It is not without wartime significance now that the Navy has embarked on an expansion program.

PHOSPHORESCENCE

You've read elsewhere in this issue that black light is going to town very largely from the boost given it by blackouts. Paralleling the rise of black light is the use of phosphorescent materials. Just around the corner is a phosphorescent wallpaper with no war implications. It will be produced primarily for use in un-modernized hotels and boarding houses lacking bedside light switches. On switching off the light, the wall paper will glow for a sufficient time to enable the occupant to reach the bed without colliding with the rocker. Why not for nurseries of children afraid of the dark?

—*Philip H. Smith*

Four Centuries Late

Science and Society Begins to Recognize a Great Inventor, Engineer, and Scientist

ALBERT G. INGALLS

ALONG in the 'twenties and 'thirties a good many Americans came to the realization that many of us had been too emotional and some of us even hysterical in some of our attitudes connected with World War I. In our rage against our opponents many of us also condemned his literature, art, and music, not alone contemporary but past. For example, many would not play Beethoven's music because Beethoven was a German, though he had been dead 90 years and had nothing to do with the events that led up to that war. Today, the great majority feel strongly about events political and military in the Old World, but it is pleasing to note that many have vowed they will not this time let their emotions run entirely away with their common sense, at least where things like art and music and science are concerned—things that belong to the whole world and to the ages.

When, some weeks ago, the New York Museum of Science and Industry obtained from Italy a collection of 275 working models of the inventions of the Renaissance Italian inventor, engineer, physicist, biologist, architect, and artist, Leonardo da Vinci, and put them on exhibition after they had similarly been on recent exhibition in Milan, nothing untoward happened. Nobody planted a time bomb or even thumbed his nose. Of course, the Italians, in willingly lending these models to the American institution, aimed without much doubt to enhance Italian prestige, but New Yorkers and others have flocked to see them, and still are flocking, probably because they simply wanted to see them. All this shows that, since 1914-1918, the nation may have to an extent grown up.

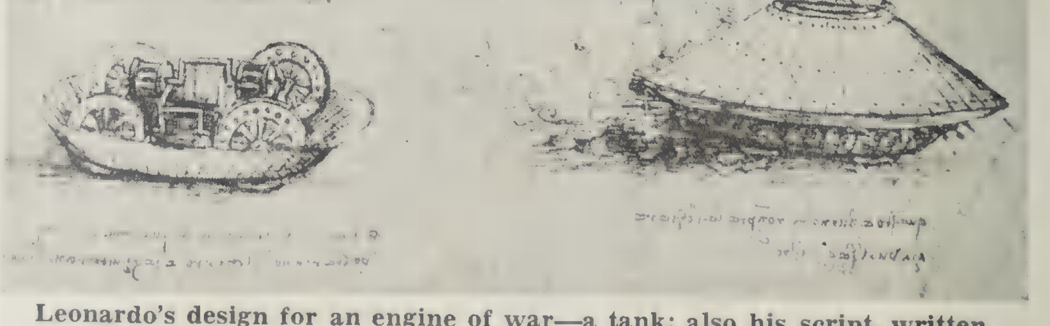
Perhaps the reader has noted that, in referring to Leonardo above, the word "artist" was mentioned last, "inventor" first, reversing the customary sequence, Leonardo usually being thought of primarily as an artist. The motive is not to belittle art, which could not be done, but to help redress a bad balance of long standing. If, a generation or more ago, one had asked the first 100 persons whom he encountered who Leonardo da Vinci was, it is believed that at least 90 might have replied simply, "A very great artist." Perhaps nine more might have been aware that Leonardo also dabbled in science, and maybe one out of the hundred, fully aware of his greatness in realms scientific, would have said that Leonardo was so able in that realm that a time would come when his abilities in it would be recognized as the equal of those in art. That time has begun to arrive.

IT is now approximately 450 years since this "tremendous universal genius" was doing his best life work, yet, even this long afterward, we know a very great deal about that work, also about the man himself. For example, we know from contemporary record what manner of man he was personally. The rather cantankerous disposition traditionally associated with great genius appears to have been no attribute of Leonardo's. His was a warm, sunny personality; he made many friends and kept them. Physically, he was not a latin type; he is spoken of by contemporaries as golden haired.

We also have, in different large libraries, the actual originals, well preserved, of the 7000 pages of notes which Leonardo penned throughout his lifetime, in which he preserved his thoughts and conceptions in the realms of aeronautics, anatomy, architecture, astronomy, botany, engineering, geology, mathematics, medicine, optics, physics, and other corners of science; for he took the whole universe as his scope. All this and other available first-hand material affords us what might be called an "in-focus" picture of the man, rather than the somewhat fuzzy, blurred, out-of-focus picture we have of many great men who lived at even later periods—Shakespeare, for example, who lived a century later.

No man of Leonardo's artistic and mechanical flair would be likely to write out 7000 pages of notes without also drawing some pictures, and thus it is that very many of these manuscripts are copiously illustrated by clear, definitive sketches, not alone of things he had seen but of things he had invented—machine designs. It is from these original notes and sketches that the modern Italians made their 275 working models, many of them full-scale, of Leonardo's inventions, a few of which are shown on these pages.

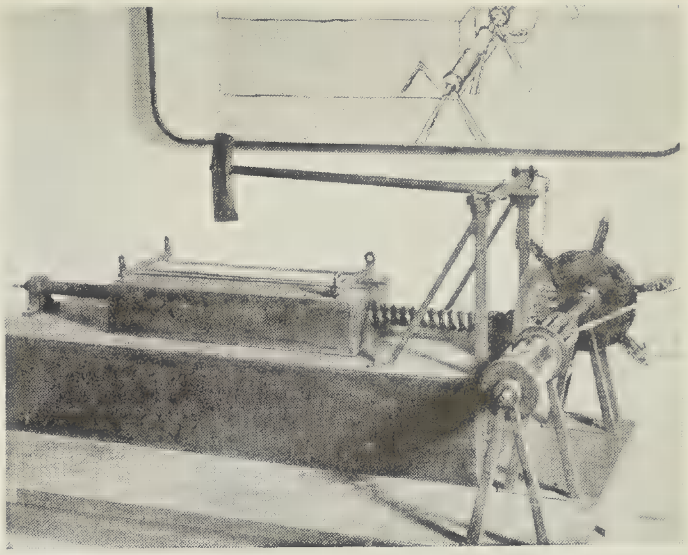
Here one might be pardoned if the suspicion rose in his mind that the modern Italian model makers might perhaps have improved on them a bit while they were at it—people often do this, unconsciously, when their heroes are involved. In the present instance there was, however, no need to do so. It is true, Leonardo did not leave dimensioned blueprints, whether of a screw-threading machine design or that of an airplane, but his sketches are as clear and definite as an engineer's notebook sketch would be if made in 1940. Thus, in judging Leonardo's abilities, little "courtesy allowance" need be made for the man's times. You get the impression, after studying his con-



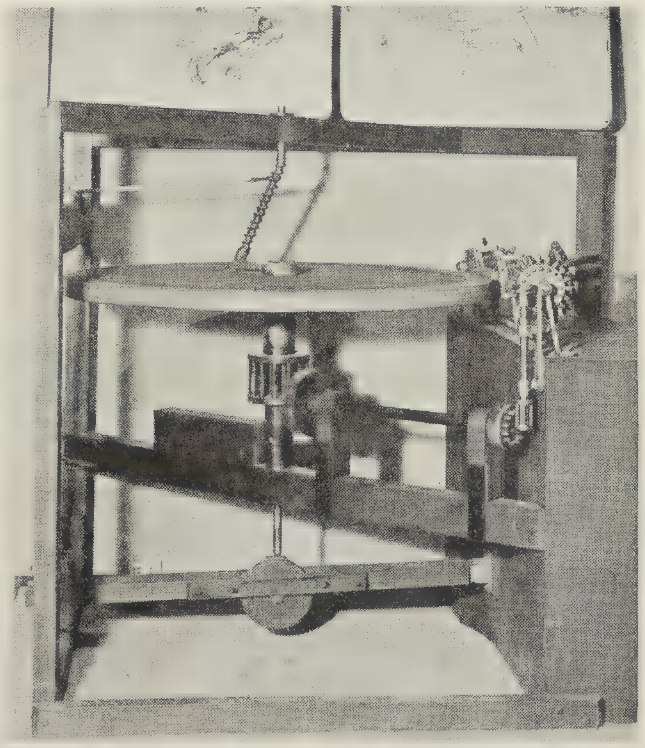
Leonardo's design for an engine of war—a tank; also his script, written from right to left, a natural, logical direction for a left-handed writer

ceptions, that this was an artist who also felt as fully at home in the world of mechanics as our engineers do today. He quite obviously had a modern mind. In fact, it does not seem exaggerated to inquire whether, had the man been born in 1847, as Edison was, instead of 1452, he would not have equalled Edison as a conceiver of inventions, not to mention his far greater versatility in other fields than invention. He invented a helicopter, the double-hulled ship, a pile driver that looks remarkably modern, the power-driven band saw, a cannon actuated by steam, the rolling mill, pumps, lens grinding machines—many other practical things.

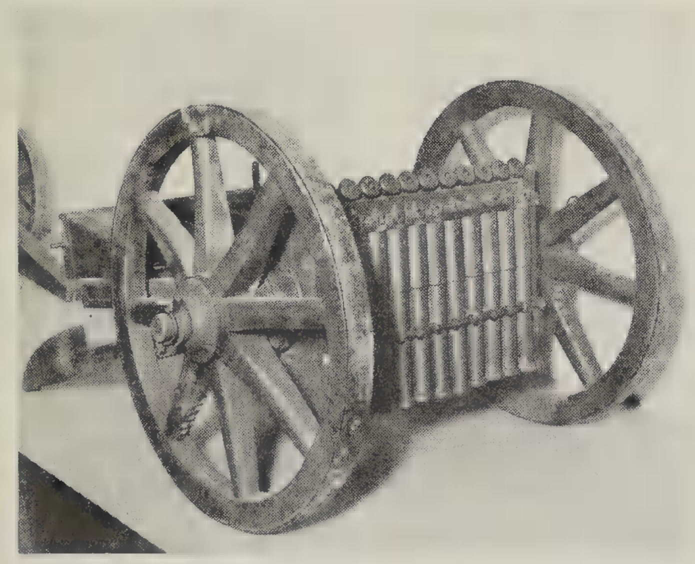
Beyond invention, Leonardo went far, for his time, into physics. He determined coefficients of friction, hinted at the principle of virtual work, studied out the principles of the composition of forces, and discovered the fallacy of perpetual motion. He also foreshadowed the principle of inertia which Galileo demonstrated a century later, and clearly defined what still later became Newton's Second Law of Matter (Galileo and Newton had no access to Leonardo's writings and probably did not know that they existed).



A file shaper built from Leonardo's design (*right*). The file blank was to be clamped on the bed-plate moved by the lead-screw, while the cold-chisel on the tilt-hammer indented the teeth serially in it



The first mass-production machine. Designed to point a number of needles simultaneously, against its horizontal, rotating abrasive wheel



This multiple cannon was not a "machine gun," as is sometimes stated, yet it is based on the mass-production principle of one. While top bank of barrels was being fired, the bank in front was cooling and the one behind was being loaded

There are at least three reasons why Leonardo's great work did not have the expectable impress on scientific advance.

First, he did not publish it.

Second, in his time no organized, far-seeing industry existed to take up discoveries and inventions, as exists in ours. Not alone this but in that age people in general were not prepared to see the value of science. Leonardo's contemporaries, for example, regarded his mechanical and similar activities merely as whims and notions, in which he was good-naturedly indulged by them because of his worth-while artistic activities.

Third, Leonardo himself lacked persistence and the businesslike, promotional type of enterprising makeup. When contemporaries failed to grasp the significance of a given idea or invention, he did not try hard to convince them or to push it himself but simply returned to his sport of thinking up more ideas. Moreover, he was inclined to lose some of his own eager interest in these ideas as soon as he had set them down on paper where they could not get away; probably this signified mainly that more ideas were pressing hard from behind.

Can it not therefore well be that the price paid by the world for Leonardo's sunny, extraverted, sociable, but perhaps insufficiently pushful, personality was just about a solid century of delay in the arrival of our Age of Science on the world stage? If he had found a way to set his conceptions in actual movement it is altogether likely that we might be, today, where we now expect to be by 2040.

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SAVING SNOW

Plowed into Rows, It Prevents Later Drifting

YOU'D think there was enough snow in Canada without hoarding any—but the Department of Agriculture in Saskatchewan has announced the development of a new technique for snow conservation, reports *Ethyl News*. In many parts of the country, farmers look to the melting snows of spring to do the work of early showers in wetting and softening the soil for plowing and planting. And since it is important to keep the snow right on the land where it will be needed

later, many experimental methods have been tried to prevent it from migrating.

The latest and simplest — and perhaps most successful — way of "tying down" the mantle of Jack Frost has been evolved by G. E. Matthews, superintendent of the Experimental School run by Saskatchewan in the town of Scott. He drags a pair of especially constructed snowplows behind a tractor, lays each level field out in ridge-rows, and the problem is solved. The ridges anchor succeeding drifts.

Canadian farmers and scientists alike have long tried to make an ally of the winter snows — getting them to wet the soil instead of running off in streams that cut gashes through the fields and leave other spots so dry that wind erosion carries away the good topsoil. Many a farmer has had to re-seed, not once but twice, while his seeded and cultivated soil has blown across the road to bury another crop.

WOOD BRIQUETTES

IN the larger cities of the West—Los Angeles, San Francisco, Portland, Seattle, and Spokane—housewives can buy a new type of fireplace log in grocery or neighborhood stores, service stations, or from the ice man. These neat, clean, and uniform cylindrical logs are pressed from sawdust and shavings from sawmills. The magazine *American Forests* reports the ever widening use of this product which provides a method of salvaging great piles of sawdust formerly wasted, or, at best, inefficiently burned in saw mill furnaces.

One of the logs weighs eight pounds and is the equivalent in fuel value of an armload of ordinary wood or a bushel basket of waste shavings. Three times the specific gravity of the original wood, these logs will not float on water.

The process of making cylindrical fuel briquettes is not exactly new, as the machine was first developed some years ago. That machine has, however, been so improved that production on a large

One log equals an armful

scale is possible. The sawdust holds together in briquette form solely through materials it originally contained — no string, wire, or sticky binders being used. The secret of its success is enormous pressure under which it is compressed—around 165,000 pounds.

HINGED BUS

Threads Traffic, Carries More Passengers

THERE recently appeared on the streets of New York a unique vehicle in the form of a bus, longer than usual, and hinged just past its mid-section. This is a new departure in surface transportation for cities of dense traffic. The articulation of the two sections permits a shorter turn than would be possible with a rigid bus of such length.

The new coach is 47 feet in overall length, 96 inches in overall width and seats 58 passengers, which is the capacity of the ordinary street car. Each of its two sections consists of the usual all-metal body construction riveted and gusseted to a steel underframing. The two sections are joined at the center on a horizontal plane by means of a hinged section in the underframing, permitting front and rear sections to move up and down irrespective of each other. A prestretched rubberized covering provides flexibility at the joint. Reverse steering on the front and rear axles gives the unit a smaller turning radius than an ordinary 40-passenger bus. Hence, it may thread its way through heavy traffic with ease.

This Super-Twin coach, made by the Twin Coach Company, is propelled by a Diesel engine of 175 horsepower, or it may be used as a trolley coach, obtaining the electricity from overhead high-voltage wires.

"MAILED"

Time Capsule Sealed In

THAT 800-pound "letter to the future," the Time Capsule, which was buried in an open pipe before the Westinghouse exhibit building at the New York World's Fair, has now been finally "mailed." During the first season of the Fair, and until late in September of the second season, millions of Fair visitors inspected the Time Capsule as it rested at the bottom of its open

Exterior and interior of the hinged bus that will reduce traffic difficulties

pipe container. On September 23, 1940, it was finally sealed off by Dr. Clark Wissler, archeologist of the American Museum of Natural History. Dr. Wissler turned a crank which emptied from a large cauldron 500 pounds of a compound made of pitch and other chemicals—a special compound concocted for long keeping qualities.

The site of the Time Capsule will be marked by a monument. It is firmly believed that no human eyes will again see it until archeological ages have passed.

Mobile unit salvages ties from an abandoned railroad

TWO-WAY TELEVISION

Demonstrated By Amateurs; Low Cost Equipment

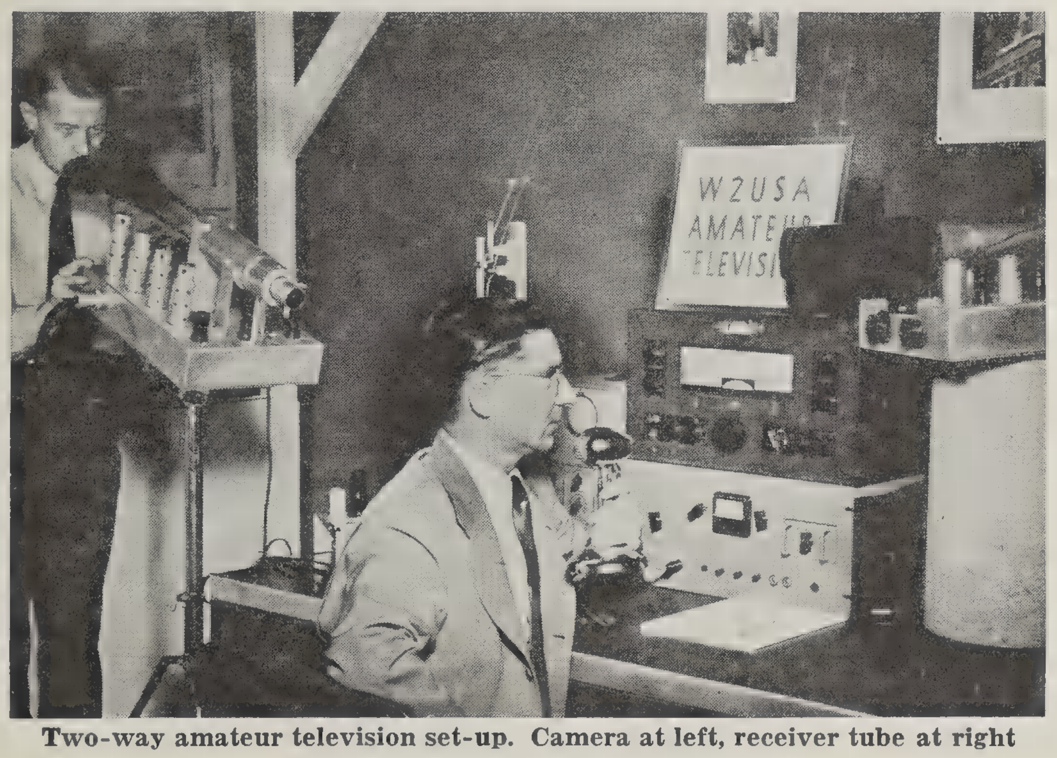
Recently announced was the opening of a two-way television circuit, operated by radio amateurs, the distance between the two ends of the aerial line being approximately eight miles.

Mr. George Bailey, President of the American Radio Relay League, the nation-wide organization of radio amateurs, who flew from Boston to dedicate the new circuit, said: "The American Radio Relay League is indeed proud to have a part in this latest indication of the thorough-going, practical-mindedness of the American radio amateur. The conception of having two complete duplications of equipment, for a two-way demonstration and then arranging for simultaneous voice transmission is one of the things we would expect from Arthur Lynch, whose interest in all amateur radio activities is well-known. We are confident that this exhibition will be another link in the chain which is binding the amateur radio man closer and closer to the average radio listener.

In commenting on the circuit, Mr. Lynch said: "The picture circuit is operating in the 112-116 megacycle amateur band—having one transmitter near the lower end, the other near the upper end. This band, if expressed in the more commonly used terms, would be said to be on two and one half meters.

"The system which we are using can never be made to compare in clarity with commercial television. We use a system which gives us but 120 lines, while the commercial standards are in the vicinity of five hundred lines. Then, too, the amount of power we use at our transmitters is only a very small fraction of the power used by the commercials. The cost of our equipment is extremely low, in comparison. A complete transmitter and receiver, of the type we are using on each end of our circuit, can be duplicated by any amateur for less than three hundred dollars. That includes all the tubes, but it does not take the voice channel into consideration.

"Our voice circuit operates on two frequencies in the 56-60 megacycle band, which is the equivalent of approximately five meters. The transmitter is equipped with several crystals, so that one of several voice channels may be selected at will, while the receiver is made with an automatic noise-gate, which prevents any sound coming from the loudspeaker until the voice of the operator on the other end of the circuit is heard."



Two-way amateur television set-up. Camera at left, receiver tube at right

UPROOTER

Abandoned Railroad Beds Quickly Cleaned Up

A machine which eliminates the tedious job of tearing up old cross ties from abandoned railroad beds and hand-loading them on trucks has been developed by the Athey Truss Wheel Company. Mounted on a Caterpillar tractor, this mobile loader pries up the old cross ties, swings them overhead, and slides them down a chute in the rear so that they are loaded onto the body of a truck.

As shown in the accompanying illustration, swinging arms are mounted on an axle near the rear axle of the tractor. Meeting in front of the machine, the two arms terminate in a two-prong, wedge-shaped fork which gouges under the old cross ties as the tractor is

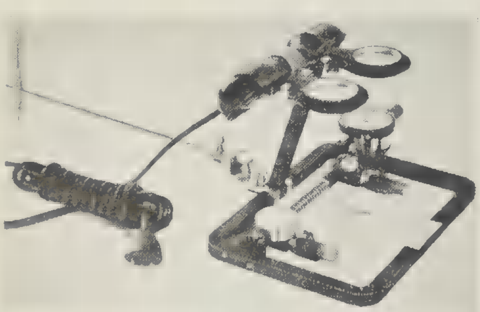
moved forward. The prong holds several of these cross ties as the arm swings up on the framework mounted over the tractor and drops its load when almost directly over the tractor driver. The cross ties slide down a flat chute to the truck. The truck is coupled to the tractor so that as the tractor moves the truck always follows.

This machine will dig up and load an average of 10 ties every 20 seconds, and with it a contractor is able to clear a mile of right-of-way per day.

CONTOUR FINDER

ENGINEERS of the immediate future won't be forced to await the findings of ground survey crews; with the advent of the compact little "contour-finder" developed by the Abrams Aerial Survey Corporation the situation is changed.

The contour-finder, adapting a principle used by our grandparents—the stereoptican—measures elevations of trees, hills, and buildings directly from a set of two aerial photographs. The drawing attachment accurately describes minute measurements, enabling engineers to run profile lines along rights of way, locate and draw contour lines around dam sites and drainage areas and obstructions in engineering work. Tedious ground-crew survey work is thus done away with, engineers being able



Close-up of contour finder

to locate "control points" in a short space of days.

The contour-finder was designed to complement the work of aerial survey crews mapping projects from high altitudes.

The instrument is a compact one equipped with a drawing attachment for obtaining topographic information from vertical aerial photographs or from oblique photographs which have been accurately rectified. It consists of six parts: stereoscope, parallax measuring unit, drawing attachment, lighting unit, carrying case, and, optionally, an alignment mechanism.

In operating the device, a pair of stereoscopic aerial photographs are placed under the instrument in such a way that two indicating dots cover the same point in both photographs. The dial gages are set at the mid-point of their range. The photographs must be at right angles to the instrument and the dots in direct line with the line of flight or base line of the photographs. They are then fastened securely to the

Contour finder in use

table. If the hand on the large dial is turned clockwise, the dot will appear to rise in the stereoscopic model and vice versa.

By keeping the instrument in alignment with the pictures and moving the instrument with the floating dot always in apparent contact with the ground, a contour line can be traced on to another map of equal scale. Higher or lower contour lines can be traced by raising or lowering the floating dot the desired vertical distance and then tracing out the constant elevation. The heights of buildings, trees, and ground elevations can be measured quickly.

FOLSOM MAN

His Actual Bones Never Found

DR. FRANK H. H. ROBERTS, JR., Smithsonian Institution archeologist, last summer continued excavations for the fifth season at the oldest known inhabited site in North America—the Lindenmeier site in northeastern Colorado.

This apparently was a summer hunting camp of the wraith-like makers of the peculiar type of spearhead known as the "Folsom point" which is found associated with the bones of extinct animals and in geologic strata dating from the closing centuries of the last great ice age.

Dr. Roberts has obtained not only a large number of Folsom points, and bones of animals eaten by the hunters, but also many artifacts used in their domestic life, such as stone scrapers and knives. Thus far he has been unable to find any human bones.

There is still hope, Dr. Roberts believes, of finding a skull of one of these Americans of 15,000 years ago. It is possible that the dead were not buried but were left exposed on the surface to be devoured by the vultures. The bodies may have been burned or there may have been a special burial site which has not yet been uncovered.

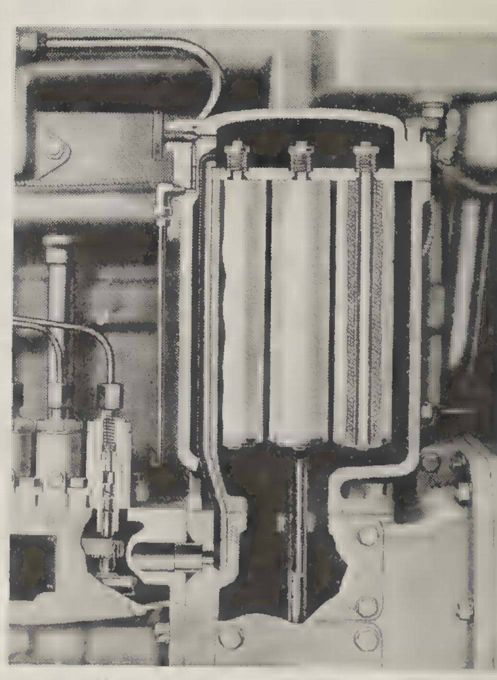
DIESEL FILTER

Cheap, Easily Removable, Protects Engine

AN ingenious and highly effective filter has been developed by the Caterpillar Tractor Company for use in that company's Diesel engines. So efficient has this comparatively simple innovation proved that laboratory tests show the new filters increase the life of Diesel injection pumps and injection valves by as much as 75 percent as compared with the usual edge-type metallic filters.

The filter elements consist of a high quality, highly absorbent type of cotton yarn, wound on an inner metallic screen, which is wrapped with a filter paper. Winding of the yarn is done in a cellular pattern, with accurate spacings which are controlled in such a way as to provide increasing density toward the center. Thus finer and finer particles are removed as the fuel approaches the center. In case an extremely fine dirt particle passes through the main elements, it is stopped by the filter paper.

The elements are easily remov-



Sectional view of Diesel filter

able and are so inexpensive that they are simply thrown away when dirty, and quickly replaced. There is a gage, mounted on the engine, which shows the operator when replacement is necessary. Elements may be removed by simply removing the cover on the centrally located filter housing, and lifting them out.

FOR WINTER

Permanent Type

Anti-Freeze

"STET," a new ethylene glycol anti-freeze, has been added to the product line of the automotive accessories division of The B. F. Goodrich Company.

The anti-freeze, the first ever offered under the Goodrich name, is of the permanent type, one filling furnishing radiator protection against freezing all winter.

Odorless, the new compound will not evaporate or boil away; rust inhibitors prevent rusting. The new product will not damage car finish, mixes readily with other ethylene glycol anti-freezes, and can be tested with the standard hydrometers for such fluids.

MINIATURE ROOMS

Observer Sees Self

In Them

A MAGIC MIRROR that projects the observer into a series of miniature rooms is the feature of the new Alexander Smith Colorama Exhibit at Rockefeller Home Center at New York's Radio City. An involved optical system actually lets you see yourself, reduced to one eighth actual size, standing in the middle of a perfectly proportioned little living room less than eighteen inches long. Most remarkable of all is the fact that you see a side view of yourself, full length, exactly as others see you and as you have never before seen yourself except, perhaps, in motion pictures.

While you have been admiring yourself in miniature, a recorded voice has been patiently explaining the theory behind the Colorama Exhibit — that women should choose color schemes for their homes that flatter their particular type of beauty. The first room, the voice explains, is for a blonde. At this point a curtain descends over the aperture through which you have been looking and when

it goes up again you find your image in another room identical to the first except for the color scheme. This goes on until you have seen yourself in five little rooms.

The optical system that reduces you to one eighth your size and projects you into the miniature rooms is not quite as complicated as might appear at first blush. A full length mirror well to one side of where you stand picks up your image, and lenses focus it on a "transparent mirror" behind which is one of the miniature rooms. The "transparent mirror" can function either as a mirror or as a piece of clear glass depending on whether the light in front of it is greater than that behind or vice-versa. As you stand looking into the aperture, a brilliant light illuminates your figure and thus when your reflection in the full length mirror is focused on the "transparent mirror," the part of the latter that receives the image acts as a mirror, whereas the rest, because the lighting in the little room is less intense, is perfectly transparent and allows you to see through the glass to the miniature room behind. The illusion that you are actually standing in the room is complete.

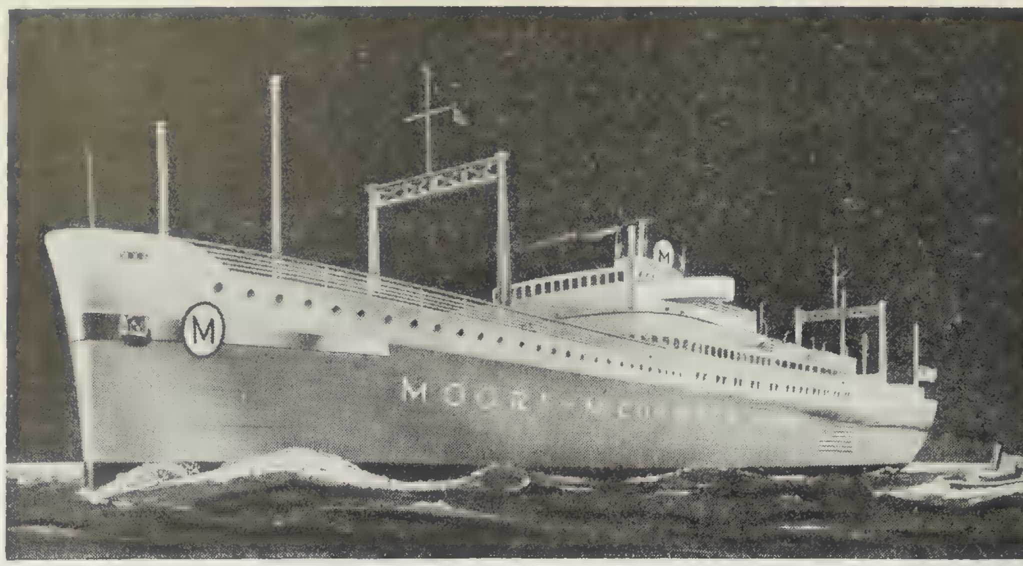
BRIGHTEST FLASHLIGHT

Small Light Throws Powerful Beam

WHAT is believed to be the brightest portable battery light in the world, smaller than a man's head but so powerful that it is possible to read a newspaper by its light half a mile away, has been developed by Mr. Jackson Burgess of the Burgess Laboratories.

The new portable lantern, with 180,000 maximum beam candlepower, is 180 times as powerful as

180,000 beam candlepower



For the tropics: 17,500 tons, all staterooms air-conditioned

the best two-cell flashlight on the market.

The spot of light cast by the lantern at arm's length is 45,000 foot-candles, which, by mathematical calculation, is four and one half times as bright as sunlight on a spot of the same size. Theoretically, at 100 feet it has 180 foot-candles which is equal to the average office illumination. The light output of the new lantern far exceeds that of an automobile spotlight or two automobile headlights.

The new light may be used by fire and police departments as emergency standby lights; and as an emergency landing light for airplanes. It may also be carried in planes to be used in emergencies as protection insurance, similar to the way in which modern air transports carry battery-operated radio transceivers.

COOL SHIPS

First to Air-Condition All Staterooms

SOMETHING new in hand-made weather for tropical waters will be introduced in 1941 when Moore-McCormack's American Republics Line supplements its regular services to the east coast of South America with four new combination passenger and freight liners.

The new liners will go in for air conditioning in a big way. They'll feature it not only in public rooms —as the newer ships are doing—but for the first time will also install it in each and every stateroom.

Pioneer vessels to be thus equipped, the new liners will accommodate 196 passengers and are being built because of the greatly increased interest of Americans in touring South America. Of 17,500 tons displacement, the ships will be 492 feet overall and will have a molded beam of 69 feet six inches. Their two Diesel engines will develop 9000 horsepower and give them a speed of 17½ knots.

AUTOMATIC COFFEE

TO the automatic toaster, which has graced many breakfast tables for years, may now be added an equally automatic coffee maker. Embodying all the features of existing glass coffee makers—clean glass bowls, fascinating operation,

Better coffee—automatically

and ease in making good coffee—the new device eliminates certain disadvantages which have been experienced by coffee makers.

The Alnico magnet, versatile General Electric product, is the key to this new appliance. A small cylindrically-shaped Alnico magnet, coupled by suitable levers to a pair of contacts, is held in its upper position by a small stainless steel keeper located on the lower end of the lower bowl tube. As the last of the water is forced into the upper bowl, excessive turbulence in the tube breaks the circuit, allowing the magnet to drop and turning off the unit. As the brew returns to the lower bowl, a thermostat turns on

a separate warming element which maintains the coffee at a temperature of approximately 185 degrees for an indefinite period.

INSECTS

Follow Armies of The World

If history is allowed to repeat, say officials of the Bureau of Entomology and Plant Quarantine, the present war may add to the insect pests that have invaded new territory because of armed conflict among men. The Hessian fly, which each year destroys wheat with an estimated value of $13,000,000, came here with the German troops hired by George III to suppress the rebellion. Turning the tables, the Colorado potato beetle crossed the ocean in 1917 with the American army and settled in France, subsequently spreading to Germany where it is a serious threat to an important food crop. During World War I, Australian wheat replaced American wheat which had been shipped to Europe. Some believe these importations introduced flag smut in America.

CHRISTMAS TREES

Fireproofed by Simple Treatment

Many people preserve their Christmas trees for long periods by inserting the butt in a container of water. The live tree absorbs water, sending it through all branches and leaves so that the decorated tree may stand for many days.

This ability of the tree to send water throughout its structure may be made use of to fireproof the tree. According to *American Forests* magazine, Dr. Martin Leatherman, associate chemist in the United States Department of Agriculture, has found that fairly concentrated solutions of ammonium sulfate or calcium chloride will usually do this job effectively. Dr. Leatherman says that the trees to be so treated should be as fresh as possible. Before treatment, an earthen crock, glass jar, or a galvanized pail should be available. Then the base of the tree should be cut on a long diagonal slant or in the form of a narrow V. The chemical preferred is ammonium sulfate, because it is cheap, effective, and easily obtained. The quantity to use should

be one fourth the weight of the tree. It is dissolved in the ratio of one and one half pints of water for each pound of chemical. The tree is then set in the solution and away from direct sunlight until most of the solution is absorbed. Dr. Leatherman obtained best results when the surrounding temperature ranged between 55 and 65 degrees, Fahrenheit. The solution absorbed more readily at this temperature and the foliage retained its green color longer than when treated in a warm room.

Treatment of trees in this manner does not mean that all fire hazard has been eliminated but only that the tree itself will not readily catch fire. Other decorations used with it should, therefore, be of fireproof quality.

MAGNETIC ALLOY

Holds More Permanent Magnetism Than Any Other

A NEW magnetic alloy of remarkable qualities, "Vicalloy," was announced recently to the American Physical Society by E. A. Nesbitt and G. A. Kelsall of Bell Telephone Laboratories of New York. Composed of cobalt, vanadium, and iron, the alloy can be made to hold more permanent magnetism than any other commercial material. In addition, it can be drawn and rolled—a property of advantage in many applications, and not possessed by other permanent magnet materials of importance in the art. For example, it has been rolled into tape 1/500 of an inch thick and 1/20 of an inch wide. Several thousand feet of this tape were used for sound-recording at the New York World's Fair, while shorter lengths are running constantly as endless loops in the Bell Telephone weather-announcing systems.

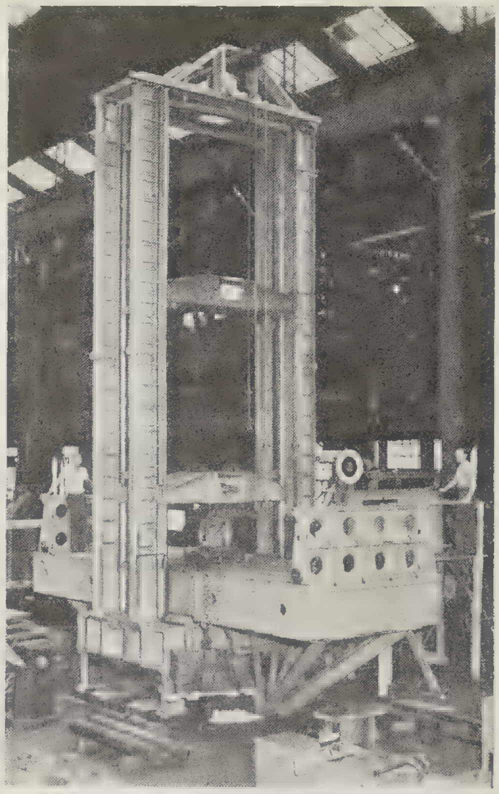
A tiny loop of Vicalloy supports several pounds of iron

Taking its name from the initial letters of its three components, the new material is composed of 6 to 16 percent vanadium, 30 to 52 percent iron, and 36 to 62 percent cobalt. From the molten state, it is cast into an ingot, which is hot-swaged to ¼ of an inch diameter. It is then drawn into wire or rolled into tape, as desired. When in final form, it is heat-treated to develop its magnetic qualities. It is permissible to use a heat treatment that will not be harmful to most high-permeability materials. Thus it is possible to weld such pieces to the magnet and heat-treat them both together.

GIANT TESTER

Materials Testing Machine Very Accurate

A 100-TON materials testing machine, so powerful that it can bend two parallel, 12-inch, steel I-beams, yet so accurately controlled that it can crack a nut without



100-ton testing machine. Note the man on the transverse table

crushing the kernel, has been built by the Riehle Testing Machine Division, American Machine and Metals, Inc. Riehle directing designers have released the following specifications: 34 feet high, 21 feet wide and 24½ feet from front to back. The transverse table, one of the largest ever built, is 8 feet wide.

Not only is the machine one of the largest ever built in the United States, as well as the world; it is also among the most accurate. Though it can exert a maximum of 700,000 pounds pressure, the mechanism has recorded a maximum error of 0.06 percent, making it one of the most sensitive machines of this type ever built. German technicians refuse to build machines more accurate than 1 percent — sixteen times greater error than this machine.

In routine tests the machine snapped 12 by 12-inch wooden timbers with a pressure of 500,000 pounds. Steel tubes three inches in diameter were crushed at 600,000 pounds pressure.

When finally set up, this machine will be used for routine testing and as a primary standard for the verification of calibrating instruments. It required eight months to build; two months were spent in design alone.

WEATHER NERVES

Basis Found for Effect Ridiculed as "Just Imagination"

IF YOUR temper and nerves get more edgy when a storm is approaching, it is probably because the water balance in tissues of your body actually is disturbed due to falling barometric pressure outside. Advancing this likelihood, Dr. C. A. Mills, of the University of Cincinnati College of Medicine, advocates that scientists should closely investigate body changes thus involved when stormy weather brews.

Suicides are more likely to occur when a storm center approaches, Dr. Mills stated. Domestic troubles flare up most readily. It is harder to think clearly. Even animals become more inclined to fight, and less reliable. "With declining outside pressure," he explained, "tissues take up water and swell, much as does a sponge, while with rising pressure they give up water and shrink." In girth measurements of his own leg just below the knee, he observed changes of half an inch or more with major weather changes, and some people changed several pounds in weight.

OUTWITTING GRAVITY

Of Two Identical Balls, One Is Lazy

TWO steel balls of identical weight and size recently disproved one of the rules of gravitation by rolling

Same weight, differing "gravity"

at different speeds down an incline. Dr. Phillips Thomas, Westinghouse research engineer, performed the experiment to demonstrate how the friction of tiny particles of loosely packed powdered tungsten inside one of the balls made it lazy by absorbing part of its energy.

Westinghouse engineers, Dr. Thomas explained, have used this same principle of energy absorption to prevent electrical relay contacts from bouncing apart when they are closed, thus eliminating sparking and reducing wear on electrical control equipment.

MILDEW PROOFING

Simple Home Treatment

For Fabrics

MILDEW can be prevented. This is the conclusion reached by Margaret Furry, Helen Robinson, and Harry Humfeld of the U. S. Department of Agriculture after studying 135 recommended treatments. Of these, 35 were effective, about 10 practical for home and farm use. Tests are continuing in the home economics laboratories.

Use of such finishes will save money, these investigators point out. Mildew proofing will help preserve tents, tarpaulins, sails, sandbags, and other pieces of canvas equipment often stored in moist or poorly ventilated places. In the home, shower curtains, awnings, and canvas on porch furniture may need treatment. Untreated cotton fabrics are likely to mildew—then develop discolored and musty-smelling spots. They may be attacked so severely that they rot and fall to pieces.

Directions for treating an average-size shower curtain illustrate

one of the simplest methods and call only for a good laundry soap and crystals of cadmium chloride, available at drug stores. Have the cloth thoroughly clean. Heat it in a solution of one to two ounces of soap to the gallon of water. About one and one half gallons will cover a shower curtain. Heat 20 minutes, remove the cloth, and squeeze out excess soap. Put the wet cloth into a second solution of cadmium chloride crystals, three ounces to the gallon of water, about one and one half gallons required. Heat for about 30 minutes, wring out, and dry without rinsing. Hang to dry on a twine line (a metal line may stain the fabric). This treatment does not affect the color of the curtain, which will be resistant to mildew until laundered again.

PLAINS PREHISTORY

Five Stages of 10,000 Years

LONG before covered wagons of white settlers jogged toward the West, at least two great migrations of red men, their wives, and children plodded westward on foot to possess the Great Plains.

New chapters of the central Great Plains prehistory, reconstructed by Dr. Waldo R. Wedel of the Smithsonian Institution from archeologists' burrowing into Indian ruins and searching Plains terrain, can be briefed as follows:

1. About 10,000 years ago, the first men and women peopled the Great Plains, roving eastward from the Rockies. Nomad bison hunters, they were some of the early Americans identified by the distinctive stone dart points known today as Folsom and Yuma weapons.

2. Then came a blank chapter, enormously long, when the Plains were apparently abandoned by man.

3. The first easterners re-discovered the Plains. They moved cautiously, were not numerous, and were peaceful Indian settlers, not wandering hunters.

4. Later a second migration of different, more progressive Indians arrived. Also peaceable, these easterners brought the gift of corn, made better pottery. They were mound building tribes. Mysteriously, these best settlers abandoned their homes and vanished, before white men saw the Plains.

5. The Spanish conqueror, Coronado, seeking non-existent golden cities, marched from Mexico as far as Kansas in 1541, and was the first white discoverer to view Plains tribes. Nomad hunters were on the rise, harrying Indian settlers. Provided in time with white men's firearms and horses, the Indian hunter became ruler of the Plains, ending Indian dominance with a brief bison-hunting era—as bison hunters had begun the conquest.

—*Science Service.*

LUMINOUS BRICKS

GLASS bricks have been used more and more widely, because of several advantageous features, during recent years. Soon it should be possible to erect walls of glass bricks which admit daylight during the day and are luminous at night. This glowing light from the bricks at night would be so well distributed that there would be no bright spots.

Electricity is passed through these bricks, which are coated inside with fluorescent material similar to that used in the widely-known fluorescent tubes. If ultra-violet light is needed in a room, the bricks can be made of materials which transmit these rays, while a small amount of mercury inside each brick would be used as the source of the ultra-violet.

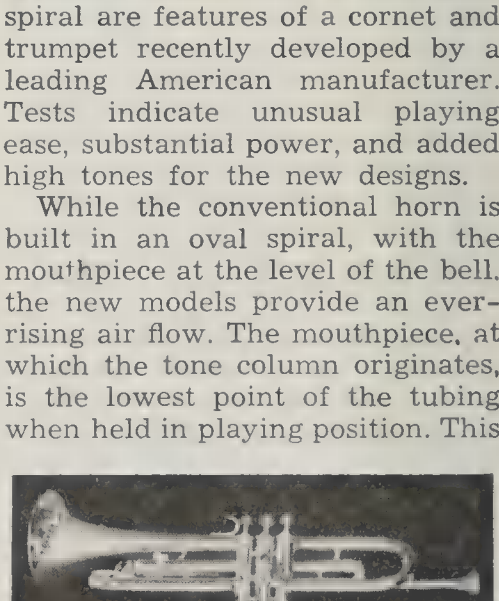
Rights to this invention have been assigned to the General Electric Company.

NEW CORNET

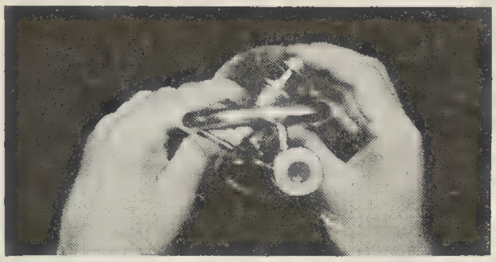
Design Changes Improve Playing, Tone

SLANTED pistons and a new tone spiral are features of a cornet and trumpet recently developed by a leading American manufacturer. Tests indicate unusual playing ease, substantial power, and added high tones for the new designs.

While the conventional horn is built in an oval spiral, with the mouthpiece at the level of the bell, the new models provide an ever-rising air flow. The mouthpiece, at which the tone column originates, is the lowest point of the tubing when held in playing position. This



". . . ever-rising air flow"



Piston valves on an angle

feature, the makers believe, may account in part for the ease and flexibility of tone production.

By installing the piston valves on an angle, a more natural and relaxed position of the hand and fore-arm is permitted, which in turn leads to improved muscular control and facility.

DANGER UNIT

Degree of Danger In Driving Cars

To measure the hazard involved in driving at various speeds, the Travelers Insurance Company has developed the "danger unit" which is defined in stopping distance, roll over, vertical fall, and turning radius, reports the *Stone & Webster Bulletin*.

Under average conditions the distance an automobile moves after its driver has decided to make an immediate stop varies as the square of its speed. A "danger unit" equals 35 to 40 feet of stopping distance. A car traveling at 25 miles per hour can be stopped in this distance, while in stopping from 50 miles per hour it will travel between 140 and 160 feet, the equivalent of four "danger units." Nearly one full "danger unit" is added when the speed of a car is increased from 45 miles per hour to 50.

In case of too sharp a turn, a car will sometimes roll over once for each "danger unit" it carries. Thus it may roll over once at 25 miles per hour, twice at 35, and perhaps nine times at 75. It is well to remember that only in the luckiest accident can the driver cling to the inside of the rolling car as it does its three turns at 45.

Striking a solid object at 25 will do a car about the same damage as if it had been driven off a two-story building. Encountering a stone wall at 50 will be just as serious as if it dropped from four times two stories, or eight stories. When Captain George Eyston was doing 300 miles per hour and more on the dry salt beds of Utah, his big engine was packing energy into his car with such industry that it was adding one "danger unit" for each mile of increased speed. Had he hit a solid stone wall he and his machine would have been smashed as completely as if he had driven off a 3000 foot ledge into Grand Canyon.

Each added "danger unit" causes the car to require a longer turning radius. Thus a car can make only one fourth as sharp a turn at 50 as at 25; one ninth as sharp a turn at 75 as at 25.

RUBBER GLUE

Non-Flammable, No Odor, Keeps Well

A new cement, Texglue, with a latex or rubber base, and compounded to afford exceptional adhesive properties and resistance to aging has been announced by The B. F. Goodrich Company. It contains no flammable solvents.

The new product is of special interest to upholsterers, awning manufacturers, and leather fabricators as well as to anyone having any requirement of adhesion of fabrics, paper, leather, or other porous materials. Texglue also will attach fabrics, paper, and other materials to non-porous surfaces, and can be easily cleaned from these surfaces when its mission is accomplished.

There are many non-industrial uses for Texglue: as an office paste, easily removed, leaving clean paper surfaces; for sealing packages; applying labels; posting bulletins. It also can be applied as an anti-skid coating for rug bases, used to repair clothing and household furnishings, and to stop runs in hosiery.

Non-flammable, with no objectionable odor, the cement can be stored in normal atmospheric temperatures, with avoidance of freezing temperatures or heat above 90 degrees.

HI-JACKING THE ANT

Farmers Get Ants' Collection of Grass Seed

By hi-jacking the harvest of buffalo-grass seed which red ants accumulate—probably as a source of winter feed—southern farmers and ranchers can sometimes gather a supply of seed at slight cost. One farmer in Bell County (Texas) got about 200 pounds of clean seed in

two days from ant hills in a pasture of native buffalo grass, says W. J. Neumann, in charge of a soil conservation project of the U. S. Department of Agriculture, near Temple, Texas.

Soil Conservation Service men, who noticed that red ants collect buffalo-grass seeds and pile them around ant hills, were able to tell the farmer how to get seed for planting. The seed material was swept together with a stiff push broom and then run through a commercial cleaner to separate the seed from soil, trash, and weed seeds.

STEEL EATERS

Bacteria Thrive on Iron and Steel

The discovery that certain bacteria living underground thrive on iron and steel pipes, causing annual rust and corrosion damages running into the millions, was announced at the convention of the American Gas Association by Raymond F. Hadley of Philadelphia, electrical engineer of the Susquehanna Pipe Line Co.

Known as anærobic bacteria because they live in an atmosphere devoid of oxygen, it has been found that they can survive for long periods of time when brought to the surface. When magnified 850 times under the microscope, they appear in the shapes of coil spirals or curved rods. They are particularly hardy. Cultures have been grown from soil water taken from under ice. They also have withstood temperatures as high as 176 degrees.

Once the bacteria have taken hold, the maximum life of a pipe is approximately seven to ten years. The rate of corrosion under their attack is nearly three times that of other types, with the exception of carbon contact, stray electric currents, and concentrated acid.

There are 450,000 miles of gas, oil, and water distribution systems in the United States, all of them susceptible to attack by the bacteria.

BUGS IN PLASTICS

Transparent Sheets for New Mounting Method

For schools, laboratories, and camps, a new method for mounting biological specimens has recently been worked out, utilizing Monsanto cellulose acetate. The mounts consist of two flat sheets with a hollow in the center of each. The specimen—butterfly, beetle, or other insect—is laid flat on one sheet with the body of the insect resting in the hollow. Another sheet of the same size is placed over this. Wings and limbs are between the sheets while the body rests in its cavity. The two sheets are then

Oval center holds the body

cemented together. The mount is now complete in a permanent, fully visible, and insect-proof arrangement.

The mounts, known as the Schwarz Transparent Mounts, are being manufactured by the Frank Schwarz Studio, of St. Louis, and distributed through the Central Scientific Company.

APPLE JUICE

"Flash" Pasteurization Product Resembles Fresh Juice

The "flash" pasteurization for preserving apple juice, developed by specialists at the State Experiment Station at Geneva, New York, provides a reliable and relatively simple method for use on the farm which will insure a product that is being well received by the public because of its close resemblance to freshly pressed apple juice.

The essential features of the method include straining the juice carefully, heating it quickly to 170 degrees, Fahrenheit, and then putting the hot juice into bottles or cans without further treatment. After standing for a few moments, the containers are quickly cooled. The resulting product possesses much of the flavor and aroma of the freshly pressed juice and will keep indefinitely.

"Until recently the only juice which could be prepared and preserved in the kitchen was tomato juice," say the Station specialists. Now, however, "apple, cherry, grape, and many other fruit juices are used daily in the home. Im-

proved quality of preserved fruit juices has been made possible by development of methods of processing within the last few years. These improved methods include continuous flash pasteurization with little or no loss of flavor, methods to exclude air from juices which formerly caused changes of flavor and deposit of undue amounts of sediment, and perfection of containers, both bottles and cans."

ART IN PLASTICS

Cold-Molding Material Makes Plaques

PLASTICS have found their way into art many times, yet usually there is some difficulty in handling them. A new cold-molding plastic, made by the Monsanto Chemical Company, Plastics Division, obviates one of the most troublesome factors

Delicate modeling in plastic

in plastics molding—the use of heat. Consequently, attractive, decorative plaques are now being cast from this material by W. L. Stensgaard & Associates. An accompanying illustration indicates the delicate modeling that is possible when using the material for casting in this manner.

The cold-molding plastic is originally in the form of a liquid. When this fluid is mixed with another and poured into molds, it hardens without heat into a durable, rigid plastic of warm color and pleasant texture.

SAWDUST STOVE

ON the West Coast there is being produced a new sawdust burner which reduces the sawdust to a gas which in turn is burned in the combustion chamber to give efficient heating. The sawdust is loaded into a hopper beside the stove. Heated by the flame above, the sawdust is converted into gas and a small amount of exhausted ash. The sawdust smoulders on the grate, does not backfire, forms no creosote, and burns continuously so long as the hopper is kept filled. Users have reported a fuel cost of 75 cents to $1.50 per month.

GEOLOGIC MUD

New Technique Verifies Geologists' Claims

MUD deposits, 500 feet thick, on the deeper parts of the ocean floor, represent the accumulation of all geologic time, some 2,000,000,000 years. Deep ocean deposits grow in thickness at the rate of two or three centimeters in from 5000 to 10,000 years. A layer of sediment ten feet thick may represent a time interval of from 100,000 to 200,000 years.

Dr. Joseph A. Cushman, director of the Cushman Research Laboratory at Sharon, Massachusetts, and a noted authority in marine geology, recently emphasized these facts as being of extreme importance in interpreting the geologic history of ocean muds, because wide ranges in geologic time are thus preserved in core samples of only a few feet in length.

Vertical core samples 10 to 12 feet long have recently been collected from the deeper parts of the North Atlantic by the Piggot "gun," invented by Dr. C. S. Piggot, of the Geophysical Laboratory of the Carnegie Institute of Washington. Core samples obtained along the line of the Atlantic cable, from Newfoundland to Ireland, contained abundant fossil remains of tiny life forms, diatoms, and the snail-like foraminifera, which reflect climatic conditions prevalent at the time of deposition. Warm water foraminifera, such as live now in the Gulf Stream, alternate with types characteristic of the Arctic. These alternations of cold and warm types of foraminifera probably correspond to the known advances and retreats of the great ice sheet that once covered half of the North American continent.

Even mud samples taken from the deepest portion of the Caribbean reflect the thickness of the great ice cap once lying far to the north. Cores from the Caribbean were described as showing definite zones of concentration of warm water foraminifera separated by zones in which they were absent.

CAMERA ANGLES

Conducted by JACOB DESCHIN, A.R.P.S.

All Contrasts In One Paper

CHANGES in the color of the printing light when teamed with a suitably coated printing paper will afford a variety of tone contrasts in the one paper. With this as a basis, the Defender people went to work to produce the paper and the method by which "complete contrast control" could be had in one grade of paper. The result is Varigam (varied gamma), and the tests we have given it indicate the method to be both successful and useful.

We made three separate tests on different occasions under the following conditions: Darkroom illumination was by red safe-light, Varigam being sensitive to the ordinary printing safelights but not to red. A negative of rather stronger than normal density was used in two of the tests and a normal strength negative in the other. Development was in D-72 diluted 1 to 2 for two of the tests and in the Defender recommended 55-D in the third. In the first two tests the bath was made up as usual and the whole batch run through in the one bath. In the last test, with the 55-D, a separate, new bath was made up for *each* print to assure like developer conditions for each of the prints. The temperature for each bath was held at 70 degrees and development was for 1½ minutes. The enlarger light source was the popular "211."

With each package of Varigam paper, Defender supplies a yellow and a blue gelatin filter, together with a cardboard filter holder between which the filters are sandwiched by binding the edges with lantern-slide binding tape. These filters are held under the enlarger lens or attached to the lens barrel with tape. By varying the proportionate length of time during which each of the filters is held under the lens, thus coloring the light yellow or blue, as the case may be, different grades of contrasts are obtained on the one paper, blue light providing contrast—yellow light, softness.

A test strip is made in the usual way. For this purpose the manufacturers recommend making a test with all blue light, but we have found it easier to judge proper printing time by cutting the exposure time in two, exposing half the time through the blue, half the time through the yellow filter. The exposure learned through this test will be the same for all other combinations of the two filters. In our test, the total exposure time was 14 seconds, and this remained the same for all the prints made from the same negative, the timing being distributed as follows: 2 seconds for the blue, 12 seconds for the yellow; 4 seconds for the blue, 10 seconds for the yellow, and so on, plus 14-second exposures made entirely with yellow light and entirely with blue light.

The resulting print contrasts gave a range from very soft gradation to very hard, with prints of distinctly different contrasts in between the two extremes, *from the same negative.*

A more convenient method of altering the color of the light is the use of the Duraline Print-Control Filter Set prepared especially for Varigam paper by Harrison & Harrison, of Hollywood, California. These are available in either the Standard Set, which contains ten filters with varying mixtures of the yellow and blue filters, or the Special Set, containing five filters. The first provides ten degrees of contrast from YB1 (very soft) to

YB1

YB5

YB10 (extra hard), while the smaller set includes YB1, YB3, YB5, YB8, and YB10. The latter is quite satisfactory and if an additional filter may be required later on, it can be purchased separately. With the set comes a dual snap holder, fitting a designated lens diameter. The filters are easily snapped in and out. In addition, a lock ring may be had for permanent attachment to the lens barrel.

The other two tests were made with the Duraline filter set, and provided an amazing range of contrasts in the same printing time for each of the prints. YB5 was used for making the test strip, after which all prints were made for the same time, the filters being snapped in and out successively in easy, routine fashion, except that in the 55-D tests, a new bath was made up for each print. This was for test purposes only, however, and is not necessary in normal working practice. An indication of the range may be seen in the reproductions made, respectively, through the YB1, YB5, YB8, and YB10 Duraline filters. If the engravings do justice to the originals, you will be able to judge of the results for yourself.

We believe that in actual use, the average worker will eventually settle down to two or three, perhaps four filters or filter combinations. (Incidentally, the Duraline filters must be used separately and not in combination with each other, since the varying combinations of blue and yellow are already incorporated in each of the filters.) The other filters will be used for those special negatives requiring other than routine treatment.

In actual use, the Varigam worker will forget all about the usual contrast designations and refer to them as YB contrasts instead. In the beginning, he will make up a panel of prints from a negative of normal contrast and bind them into a folder or mount them over his printing table. This panel he will use as a guide in selecting the proper filter to use with a particular negative. If the negative is softer or harder than normal, he will make the proper allowance, just as he would with different grades of paper. The advantage with Varigam, however, will be that a change in the filter rather than the paper is all that will be called for. After the worker has become accustomed to processing Varigam, he will refer to contrasts not as normal or medium or hard, but as YB5, YB8, and so on. And this, we feel, is a very definite and helpful advance in the art of printing.

Movie-Making With a Purpose

If you make a plan and try to stick to it, your movie-making activities will be the more valuable because they will build up to a definite goal rather than a miscellany of disconnected short lengths. Moviemaker George Post, of New York City, who, incidentally, has been shooting Kodachrome exclusively ever since it appeared on the market, has a scheme that, to our mind, is worth imitating. George has a rather wide range of interests, finding pleasure in shooting either flower closeups or the Cuban dancers at the World's Fair, scenic effects in the country or subjects in the intimacy of his own home. But one thing he abhors, and that is mixing his interests on any one reel. The plan he follows is this: Whenever he comes across a subject he likes, he shoots as much film as he thinks necessary and spools it onto an empty 400-foot reel. If his next subject is in another category, he spools it onto still another reel even though the first has only 50 feet on it. When he has occasion to shoot another aspect of the first subject, he adds this footage onto that reel. And thus he proceeds until the 400-foot reel of the *one subject* has been filled. In this way he edits as he goes along, cutting off what he does not want before splicing it. He tries when possible to get at

YB8

YB10

Fifth Annual Scientific American
AMATEUR PHOTOGRAPHY CONTEST

[For Complete Contest Rules, See Page 286, November 1940 Scientific American]

OVER $1200 IN PRIZES

36 PRIZES PLUS Three Special Awards

IN this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules. In addition to the seven major prizes and five honorable mentions, there will be three SPECIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners. *These special awards will be given in addition to the regular prizes that the pictures win.*

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

Division 1. Human interest, including camera studies of people, animals, and so on. Portraits will be grouped in this division.

Division 2. Landscapes, including all scenic views, seascapes, and so on.

Division 3. Action, including all types of photographs in which action is the predominating feature.

THE PRIZES

1st. Three $125 LONGINES, Coronation Model, Solid Gold, Men's Wrist Watches.

2nd. Three $85 LONGINES, Presentation Model, Solid Gold, Men's Wrist Watches.

3rd. Three FEDERAL No. 246 Photo Enlargers (List Price $49.50).

4th. Three FEDERAL No. 345 Photo Enlargers (List Price $42.50).

5th. Three PIERCE CHRONOGRAPH Men's Wrist Watches (List Price $19.75).

6th. Three BERMAN-MEYERS Flash Guns complete with case (List price $15).

7th. Three FINK-ROSELIEVE Vaporators (List price $12.50)

HONORABLE MENTION

1st. Three Fink-Roselieve "Hi-Spot" Hollywood type spotlights.

2nd. Three Mimosa Perkino developing tanks.

3rd. Three Raygram Wood-Chrome Tripods.

4th. Three Fink-Roselieve Audible Timers.

5th. Three Fink-Roselieve Satin-Chrome Range Finders.

THREE SPECIAL AWARDS!

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest. To the contestants who entered these three photographs will be presented the following special awards:

1st. One No. 715 Weston Exposure Meter (List price $24.)
2nd. One No. 650 Weston Exposure Meter (List price $19.95.)
3rd. One No. 850 Weston Exposure Meter (List price $15.50.)

THE JUDGES:

McClelland Barclay, artist
Ivan Dmitri, artist and photographer
T. J. Maloney, editor of U. S. Camera
Robert Yarnall Richie, photographer

Address all Entries to

Photograph Contest Editor, Scientific American

24 West 40th Street New York, N. Y.

least 400 feet of any one subject he tackles, though the period between the first shooting and the last may be a year.

Spiral Binding

YOU can now bind your own pictures in the same way the big annuals do. Select a group of your best shots, preferably centering around a single subject—the baby, for example—mount them on thin cardboards or use double-weight prints unmounted, and send them along to a firm that makes a specialty of this service. You must also provide a front and a back cover, which may be heavy cardboard of a desired color. It is recommended that 25 double-weight prints should be the maximum selected for any one book; otherwise, the books become too bulky and awkward to use. Prints should not be larger than 8 by 10 inches. The charge is only 15 cents for each book. The firm is Spiral Bindings, 148 Lafayette Street, New York City, New York. Mailing charges are extra.

Local Boy Makes Good

A BORROWED camera, much enthusiasm and first-hand knowledge of the terpsichorean art, started 27-year-old Constantine, New York City dancer (he prefers to use this name just as he has done in his dance work), off in photography a little less than a year ago. Unaccustomed as he was to the vagaries of the camera shutter and finder, he cut off heads, legs, et cetera, and wept afterwards at what he called his stupidity, although, as everybody knows, the name for that is inexperience.

In time, however, he was able to get the dancing figures intact on the film and to make creditable prints. As he gained proficiency, confidence came along too, until the day came when he felt he was good enough to deserve a camera of his own. To make a long story short, he now has professional equipment, including a

7th Symphony of Beethoven

From the prompter's box

miniature camera and the Speed Graphic, using the latter for flash work almost exclusively, and has assumed the mantle of dance photographer.

The best part of our story is that Constantine did so well that the Ballet Russe dancers permitted him to come backstage for posed flash shots and work from the prompter's box with a miniature camera during the performance. He used the Contax in the latter vantage point and was able to get very good stills of action at 1/50 second with the *f*/1.2 Sonnar lens wide open. The pictures he made on these occasions turned out so successfully that the Kamin Gallery in New York City staged a one-man public exhibition of a selection of his best pictures. Specialization in the one field he knew particularly well is undoubtedly the reason for Constantine's sudden rise to fame.

Printing-In Clouds

We recently had occasion to print clouds into a bald sky, yet retain a sharp outline of a projecting figure in the foreground. The job was accomplished in a rather simple manner. Instead of the usual procedure of making an exact outline of the foreground and keeping it shaded with painstaking exactness while the clouds were being printed in, a rough outline was made for the foreground. The sky being dense, a straight projection of the negative provided the foreground subject image, with nothing but white paper where the clouds were to be.

This print was then placed in the developer. As soon as the image had come up very lightly, the print was removed from the developer bath and placed in the stop bath. It was then swabbed with cotton and placed on the easel again, with a blotter underneath to protect the easel. The cloud negative, which was previously strip-tested, was then projected while the foreground was shaded roughly with the rough outline mentioned. The exposure complete, the paper was re-

placed in the developer and left there for the full time, after which it was placed in the stop bath as usual, fixed and washed. The result showed sharp image outlines with clouds printed into the bald sky, the whole giving the effect of having been made from a single negative—no break was to be seen anywhere.

Light Makes the Picture

WITH great economy of light reflections, with only the salient points high-lighted and the rest in semi or complete darkness, the accompanying illustration of the outdoor musician was made at night outdoors by the light of a few small ceiling

"Night Concert"

bulbs. Shooting from street level up to the band-stand, the exposure was 1/10 second at the full opening of the Tessar *f*/3.5. The light outlines the instrument in just the right places, providing just enough high-lighting for the purpose and no more. Vibration of the instrument is apparent in the outline high-lights, thus affording an impression of a tuba (or whaddya call it) in full blast.

Touring Exhibit Proposed

FEELING that some method is in order for giving impetus and assistance to local photographic contests, Albert Greenfield made the following proposal in a recent issue of the *New York World-Telegram* ". . . to formulate plans for a traveling exhibit of photographic equipment, combined with local photographic contests under the auspices of a grand council comprised of representatives of every organized trade association in the photographic field."

"Why forget about the amateur photographers?" asks Mr. Greenfield. "They are the ones to see and inform about new equipment, and in their interest lies the market of the photographic industry.

"The traveling exhibit that I have in mind could start in New York City, go to Philadelphia, then to Boston and

to every important city in the East. This exhibit would then cover every important city in the South and Mid-west, and eventually reach the West Coast. After a complete tour of the country has been made, a new revised show would be organized again to tour the country."

Sounds swell, Al. When do we start?

For Ferrotypers

IF you have been having trouble ferrotyping your glossy prints on chrome-plated tins, check over your procedure and see if the following may help you to get better results. After the prints have been washed, rinse them in warm water before laying them down on the warm-water washed tin. Pass a rubber squeegee over the backs several times, length-wise and cross-wise. Then sponge over the back with a squeezed viscose sponge, making particularly sure that all water has been forced out at the edges of the print, as well as from the entire surface. Incidentally, single-weight glossy prints are easier to ferrotype than double-weight paper.

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WHAT'S NEW

In Photographic Equipment

SOLAR COPYING STAND ($17.50): For use with any type camera with suitable bellows extension or supplementary copying lens. Adjustable camera supporting arm permits camera to be brought down within eight to ten inches from baseboard, depending upon size of camera used. At top distance camera is about three feet from board. Sliding rod, hexagonal shape, permits in-and-out adjustment over eight-inch range, making possible to set camera at any of six different angles. Complete assembly includes standard Solar baseboard, upright standard, and adjustable camera supporting arm.

F-R ADJUSTO PRINT PRESS ($3.95): Accommodates 100 prints between blotters. Heavy, all-steel construction designed to eliminate warping. Dimensions 12 by 15 inches; takes prints up to and including 11 by 14. Top section of press fastened to bottom section with two locking lugs. Four rubber snubbers on base prevent scratching of any surface where press may be placed.

AGFA VIKING CAMERAS ($13.75 to $18.75): Equipped with $f/6.3$ or $f/7.7$ anastigmat lens. Take eight pictures $2\frac{1}{4}$ by $3\frac{1}{4}$ or $2\frac{1}{2}$ by $4\frac{1}{4}$ inches. Standard equipment includes built-in, body shutter release; optical eye-level and reflecting, waist-level finders; hinged back and easy-loading spool carriers; self-

erecting front. Both models focus from 5 feet to infinity; shutter speeds, 1/25, 1/50, and 1/100 second, bulb and time exposures.

TIMETER ($24.85): Synchronized exposure meter and automatic timer for use in enlarging. Electric-controlled light measurement eliminates use of test strips, providing indication for correct grade of paper to use for given negative. Timeter provides precision control, accurate readings,

synchronous calibration, automatic timing, complete paper speed chart of all papers. Exposure time range 3 to 120 seconds. Light meter range 1/100 to 4 foot candles. Paper speed range 0 to 100 Timeter rating. Plug meter into 110 volts, 60 cycles AC electric socket.

GEM KOLOR CHROME: ($1.25) Developer-toner permitting toning simultaneously with development. Available in five essential colors: sepia, blue, green, magenta, yellow. Kit includes three units: developer, toner, fixer. Many shades and hues possible by mixing colors in various combinations. Any print already made in black-and-white may also be toned. Can be used for toning various portions of print in different colors. Colors controlled locally on finished print. Permits making color transparencies from regular black-and-white negatives.

FOTOFOAM ($.75): Cleansing agent for photographic use. Cleans films and plates. Drying time speeded 25% to 40%. Aid in retouching, reducing, intensifying, toning. May be used to clean tanks, trays, glassware.

FLUOR-O-PHOTO ($102.50 for light and stand, less tubes): Bardwell & McAlister eight-tube fluorescent light, Type 15. Tubes 24" by 1½", 20-watt, either white or daylight type. Individual starting switches replaceable by using small friction socket furnished with each light. Normal height range 5 feet to 9 feet. Special counterbalance stand permits easy raising or lowering. Accessories available for unit include low arm adapter called "Knee Bracket." With this, light may be operated from as low as two feet to height of five feet. Wing shades, mounted on sides, also available.

AGFA INFRA-RED FILM: Now available, in addition to 35mm, in three popular roll-film sizes—A8 (same as 127) $.40; PB20 (same as 620) $.45; B2

(same as 120) $.45. With suitable filter is specially sensitive to deep red and infra-red regions of spectrum, recording blue skies in dark tones, and green foliage, light-colored buildings, white clouds and similar subject-matter in various tones from light gray to clean white. Requirements: bright sunlight and red or other blue-extinction filter for exposures, which average, with filter, 1/25 second at *f*/5.6 to *f*/6.3. Film is fine grain, has moderately brilliant gradation and effective type of anti-halo protection.

Kodak Electric Timer ($9.50): Sixty-minute timer for A.C. only. Neatly designed die-cast case finished in smooth gray. Large dial with easy-to-read figures; minute and second hands.

Filmo Fader: Designed for professional effects with amateur movie cameras. Adjustable indicator visible in camera viewfinder shows when fades and wipes are completed. Fader said to be automatic; fits all makes of 8 and 16mm cameras and makes fade-ins, fade-outs, wipe-ons, wipe-offs, and, where camera is equipped to rewind film, transitional lap-dissolves. Fader can be mounted at any angle to permit wipes to appear or disappear from any direction. Fades made with rotating disk graduated from opaque black to clear sector, and back again to opaqueness.

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THE ROUND TABLE

Questions Answered for the Amateur Photographer

Q. **Can you supply a formula for writing over the numbers on glass graduates to make them more visible?—L. K.**

A. An effective "ink" for writing on glass so that no matter how much water is passed over it, it will not be washed off, is the following:

Shellac, unbleached	4 drams
Alcohol (95%)	4 ounces
Borax	7 drams
Water	6 ounces

Then add 12 grains aniline (adding any desired color).

Q. **I don't understand why it should be necessary to make the labels referred to in your item on "Labels on Bottles," issue of August, 1940, out of photographic paper instead of ordinary paper of corresponding quality—for instance, high-grade bond writing paper.—H. Y.**

A. Fixed-out photographic paper is recommended in order to prevent streaking when the varnish is applied. Photographic papers are coated, or sized, with baryta in order to provide a hard surface for the emulsion to be spread upon evenly and without streakiness. The baryta fills the pores of the paper, like a sizing, and keeps the emulsion (or varnish, in the present instance) from sinking into the paper. The baryta coating stays in the paper whether a photographic image is made or not; as a result, it provides a useful surface for the labeling method described.

Q. **On occasion, I like to take portraits at home or in the homes of friends, but almost invariably run across the problem of what to do for a plain background, which seems to be ideal. What is your suggestion for a good all-around portable background that can be rolled up and put away when not wanted?—N. L.**

A. A sheet of white muslin or other white cloth will provide the greatest utility inasmuch as a varied range of background tones can be provided by the way the light source is arranged. Get some half-round molding and cut it the width of your background (four feet to six feet). Cut four lengths the same size. Sandwich one end of the cloth between two of the half-round strips, nailing them together; then do the same for the other end. In use, the background is hung by a hook on a wall or tall piece of furniture, the molding at the lower end providing the weight to keep the background stretched taut, thus preventing folds and creases.

Q. **What is the adhesive used for binding together two sheets of mounting board to prevent curling or to give increased thickness or weight?—D. M.**

A. A stock batch of the following adhesive is made up for use as wanted. Fourteen ounces of any good quality glue is dissolved in 26 ounces of water. To this is added 1 ounce of a solution composed of one part of shellac in seven parts alcohol. Keep stirring until the solution cools. One-half ounce of dextrine is now dissolved in 7 ounces of alcohol and 3 1/3 ounces of water. Stir and place the vessel in warm water until the solution is complete. The two solutions are then mixed and cooled. For use, a small piece is cut off as wanted and liquefied by warming.

Q. **I find that in using the dry mounting method, my prints start peeling off not long afterwards. Is there any cure-all for this situation?—F. N. H.**

A. First of all, as you probably know, the tissue must be tacked to the back of the print, and print and tissue trimmed together. Tacking should be done from the center outwards and not from the corners inwards. That is, run the iron in cross lines from top to bottom and across the back of the print, leaving the corners free. Lay the print in the appropriate position on the mount, overlay a sheet of paper and apply the iron from the center out. Move the iron very slowly, giving what experience must teach you is about the right timing to do the job effectively.

YOUR FIREARMS and FISHING TACKLE

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; fishing tackle is a requisite of one of the world's oldest occupations. Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department which welcomes correspondence from readers.*

For "Defense"!

"A WELL-REGULATED militia being necessary to the security of a free State, the right of the people to keep and bear arms shall not be infringed."—Article II of the 10 original amendments to the Constitution of the United States of America. These first 10 amendments, known collectively as "The Bill of Rights," were proposed at the first session of the First Congress, meeting in New York City, September 25, 1789. After ratification by 10 of the 13 states, they were declared in force December 15, 1791.

The exploration, settlement, and growth of the United States from the wilderness it was in 1791 to the nation it is in 1940 owes so much to "the right of the people to keep and bear arms" that the statement of that obligation needs no amplification. Today, privately owned guns of that era of personal and territorial protection have been almost entirely replaced by what are known as "sporting arms." The nearly 7,000,000 American owners of these guns annually pay about $12,000,000 for hunting licenses and fees; close to $3,000,000 in Federal excise taxes on sporting arms and ammunition; better than $2,500,000 for Federal Migratory Bird Hunting stamps. Practically every one of these dollars in this 15-million-dollar-a-year business is spent by Federal or State agencies for rehabilitation of American wildlife, which, despite misconception to the contrary, was eliminated, depleted, or endangered not by hunters, but by economic forces and activities that deprived wildlife of natural breeding and feeding grounds.

As pointed out editorially on page 243 of the November issue, proponents of anti-firearms legislation have for years tried to curb "the right of the people to keep and bear arms," annually originating as many as 100 bills in state legislatures. Had the last Congressional proposal passed, seven million licensed sportsmen and other private owners of arms would have (1) registered and paid a dollar fee for each gun owned or bought in the future; (2) been "mugged" and fingerprinted; (3) paid a transfer fee if a gun was sold. Now, once again, this old bogey threatens, but behind its mask of "national defense" we find the same glaring and idiotic fallacy of expecting subversively-minded people to step forward and register guns held for lawless purposes.

Registration of guns owned by citizens of the United States is unnecessary as a national defense measure. It cannot conceivably achieve the purpose claimed by its sponsors, because banditry and homicide, Naziism and Communism are practiced not by the gun, but by the man behind it. As he is notoriously known to have no use for this country's laws as they exist today, why should we believe he would respect a new one? To attempt to eliminate military weapons from subversive elements through registration of all arms, including your own sporting rifle and shotgun, would be silly, impracticable, and impossible on the face of it, but such action might result in untold injury to national defense. If, as a further "defense" measure, all registered guns were to be impounded—far from an hysterical thought—we would have the ridiculous and pitiable picture of a nation that had disarmed its law-abiding citizens and which had left the lawless ones in our communities fully equipped with weapons.

If, as is generally agreed, the recent Federalizing of the National Guard, and the conscription and calling of men into training indicates "A well-regulated militia being necessary to the security of a free state," then the rest of those priceless words are as applicable and as potent today as they were when written into our Constitution 150 years ago, and, if straight-thinking people have their way, "the right of the people to keep and bear arms shall not be infringed."

On The Solunar Theory

LAST summer we fished a certain lake carefully and consistently from August 21 to September 1. On the 21st we were throwing back small-mouth black bass because they were too plentiful. From August 28 to September 1, we frequently repeated that process, but from the 21st to the 28th we had very little action, and now, perhaps, we've found out why. We've just read John Alden Knight's newest book, "The Theory and Technique of Fresh Water Angling," and have not only found it packed with sound knowledge of the elements of angling, but, what is more pertinent to our spotty fishing experience, the book also contains chapters on "Habits of Fresh Water Fish" and "The Solunar Theory," the latter having been advanced by Mr. Knight some years ago.

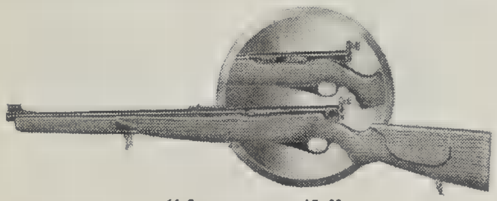
Whether you attempt to prognosti-

cate angling luck by the tides, wind direction, moon phase, color of sunset, leaf action, bird songs, or other pet theories, or just "go fishin' " you will be interested in Knight's statement that, "unquestionably the phases of the moon affect the lives and habits of all living things." Testing this thought in practice, the author established a system which worked quite well for several days each month, but the occurrence of regular lapses led him to investigate further. Following the theory of ocean fishermen that tides bring food to fish, thus establishing feeding periods, Knight felt there might be connection between feeding cycles of fresh and salt water fish. This brought him to causes of the tides and consideration of sun as well as moon phases. "Finally," he writes, "by discarding the tide tables and doing my own calculation of the actuating force by charting the resultant of the solar and lunar forces as applied to the earth, I found the schedule could be made fairly accurate. In so doing, the name 'Solunar' was coined —purely as a convenient term for describing the force in question. Thus was the Solunar Theory born."

Perhaps you've seen or used Knight's Solunar Tables, first published in 1935, and if so, you've formed your own conclusions. Possibly you've said, "Pooey!" to the whole thing. The fact remains that on checking this year's Solunar Tables, which we did *not* have along last August, with the meticulous record of wind, weather, water and air temperatures, and time of fishing, which we did keep, we found that the Solunar periods had closely coincided with our moments of best fishing. Perhaps it's still "Pooey!" in your estimation, but the constant application of science to the unknown in angling is slowly teaching us more about fish propagation, culture and habits, fishing tackle and how to use it to best advantage. Surely, we'd all be Methuselahs if we lived long enough to know all there is to know about fishing!

They Won Guns

FROM the amazing number of 18,000 entries in the O. F. Mossberg & Sons, Inc., "Rifle Name Contest," (May, 1940, Scientific American) the judges selected "Armsworth," submitted by Albert Campbell, of Richardson Park, Delaware, as prize-



"Armsworth"

winning name for the new Mossberg "M" model rifles. Second prize was awarded to Emery R. Fry, Oregon, Illinois, for submission of "Moss-K-Teer," and third award went to George H. Webster, Sheffield, Alabama, for suggestion of "Carbineer," a name also sent in by other entrants. Decision in the last instance was based on the best 20-word statement submitted with the entry. Each winner was awarded a cash prize and his choice of the three "M" rifles, and each chose the automatic, Model 51 M. Consolation prizes were given to 15 other contestants, and after it was all over, Iver Mossberg was so gratified at the wide-spread interest shown that he remarked: "Makes you want to work even harder to give 'em the biggest gun value in the world." We still have a few catalogs showing the "M" models and other Mossberg products. Want one?

"Fender Hunters' " Delight

WE once knew an old-time Michigan woodsman who had his own term for fireside hunters. He called them "fender hunters" because they never took their feet off the fireplace fender and spent most of the day and night arguing about whether wolves really attack people, how high and how fast do ducks and geese fly, are white-tailed deer frightened by a hunter's campfire, and a lot of other problematic things in woodcraft. The answers to these and other famous questions will be found in a colorful, informative booklet by Goodrich Division of Hood Rubber Company. It is called "Campfire Debates" and has a companion publication entitled "How Smart Are Dumb Animals?" We've a supply of each and will be glad to send them to you.

• • •

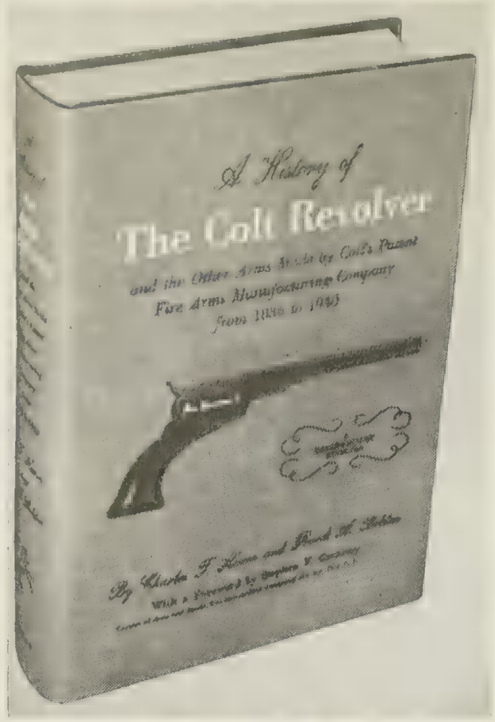
POT SHOTS
At Things New

REMINGTON ARMS COMPANY answers demands of increasing army of big game hunters for autoloading rifle in caliber approaching ballistics of popular .30 Springfield '06 by producing modernized Model 81 "Woodsmaster" in .300 Savage caliber. This combination of recent type, rapid firing

"Woodsmaster"

rifle with cartridge of 2660 fps velocity, low trajectory—three inches at 200 yards—is highly effective, produces splendid accuracy and is under shooter's control at all times because trigger must be pulled and released for each shot. In addition to .300 Savage caliber, "Woodsmaster" is available in .30 Rem., .32 Rem., and .35 Rem. calibers.

MERSHON COMPANY, INC., formerly Fray-Mershon, Inc., depicts scores of gunner and angler necessities in their new 1941 catalog. In addition to an excellent line of firearms and accessories, equipment for archery,



Here it is! We termed it a "magnificent publication." (See article on page 284, November)

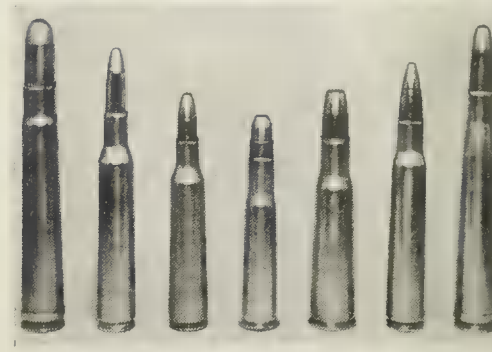
• • •

camping, and winter sports is shown. Of special interest to fishermen will be Mershon's "Reel-Fold" line dryer, which conveniently clamps anywhere, dries two or more lines simultaneously, reverses lines end for end, coils them to any desired circumference, is rust-proof and packs into a 1½ by 10½-inch unit for tackle box storage.

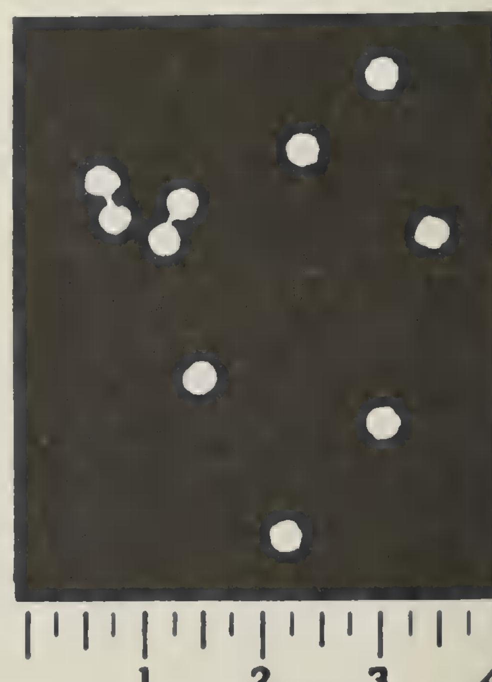
Abercrombie & Fitch, in presenting their newest and customarily "tops" catalog, perfectly express our feelings about guns when they inscribe the first page: "We like to believe that a fine sporting gun does more for a man than merely bring game to bag. A gun is the link between men and the out-of-doors. It is the lodestone that draws sportsmen together. It is a symbol of the woods, of relaxation around campfires, of companions who have shared adventures. A good and well-used gun stands for the finest moments in a sportsman's life." The book's 136 pages are attractively covered, profusely illustrated, completely indexed, and contain every conceivable need for the gunner.

J. Stevens Arms Company's newest shotgun innovation is Model 240, a .410 bore over-under, with 26-inch close-choked barrels, weighing 6½ pounds, chambered for the 3-inch .410 shell and selling at astonishingly low price of $15.10. Like Stevens' extremely popular model 530M side-by-side double gun, which came out a year ago, the new over-under has stock and fore-end of Tenite, that hard, tough plastic which will not swell, split, warp, or crack and which so perfectly resembles knurled walnut.

Western Cartridge Company's recently announced Silvertip bullets, made in 18 calibers, establishes new high in hunting ammunition accuracy. Target shown was made with .30-'06, 180 grain Silvertip fired from machine rest under normal outdoor conditions. New principle of scientific construction produces remarkable accuracy at all hunting ranges. The Silvertip has a double jacket, the outer Lubaloy metal protecting the rifle bore, the inner of nickel silver encasing the point and soft lead core nearly to the base. Differing from ordinary soft nose or hollow point bullet which spreads on contact, Silvertip's light casing delays expansion, permitting bullet to penetrate hair, hide, tough tissue without loss of bullet weight. After penetration, bullet rapidly expands to about twice original diameter, Lubaloy jacket then curls back, forming supporting shoulder for expanded core. Careful determination of proper thickness of tip casing and amount of exposure of tip result in correct penetration and expansion at all ranges.



The Silvertip cartridges . . .



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. . . a 300-yard target . . .

. . . and bullet expansion

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THE BIRTH AND DEATH OF THE SUN

By George Gamow, Professor Theoretical Physics, George Washington University

DEDICATED to Professor Henry Norris Russell, this book is a popularization, as far as its abstruse subjects can be popularized, of the study of subatomic energy and stellar evolution. Astrophysics being an extension of physics beyond the laboratory (the two in actual fact are one), a large part of this book deals with the anatomy of atoms as such, the transmutation of elements, and sub-atomic energy. The remainder—130 pages—might almost be called a popular astrophysics but it isn't "fluffy stuff," for all its popularization, nor yet is it "deep stuff." A serious book. (238 pages, 4¾ by 8¼ inches, 76 illustrations.)—$3.10 postpaid.—*A. G. I.*

THE THEORY AND TECHNIQUE OF FRESH WATER ANGLING

By John Alden Knight

IF all anglers of this generation could have had the advantage of reading this book before beginning to take their trout and bass fishing seriously, they would have been saved much time, money, and grief. If they, together with prospective anglers, will read it now, they will find a mine of valuable knowledge, enjoyably presented by the Instructor of Fly Fishing at Columbia University, the unique position held by the author of this and other angling volumes, as well as of the famous Solunar Tables. (223 pages, 7 by 9¼ inches, 18 illustrations, 4 color plates of lures.)—$3.85 postpaid.—*A. D. R., IV.*

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By John B. Walker

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By George Ross Wells, Professor of Psychology, Hartford Seminary Foundation

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Conducted by ALBERT G. INGALLS

BOSTON, traditional home of the bean and the cod, is said to have slipped somewhat in beans, but in telescope making it has come up a long way since the organization, some years ago, of the enterprising Amateur Telescope Makers of Boston. Leading spirit and first president of this organization has been W. H. Hargbol, 600 Beech St., Roslindale, Mass., (a postal station in Boston), and this column has too long been remiss about describing Hargbol's telescopes, three of which are shown in Figures 1, 2, and 3.

Hargbol began, some years ago, the same as any typical amateur, by making a modest first telescope, and the rest simply followed as usual by a kind of internal compulsion: he has now worked, he says when questioned, on 125 to 200 telescopes for himself and others, and he instructs in formal university extension classes at Harvard and at the Franklin Union Technical Institute. He does all his mirror work by hand.

Figure 1 is an 8", $f/6.5$ portable, with brass-covered galvanized tube.

Figure 2 is a 10", $f/6.2$ portable, with a tube of 3/32" Bakelite. This is attached to the declination axis spider casting by means of two long rails. These in turn are attached to two end brackets screwed respectively to the cell and to the central tube ring, so that the tube itself does not touch any of these except the ring and cell.

As Figure 2 shows, nearly half of the total tube length lies above the central ring, and this part may be rotated, the ring shown being divided in two parts. Hargbol was warned in advance that such a long rotated tube end usually is difficult to maintain in accurate geometrical relation to the lower end, and causes adjustment troubles. He therefore saw to it that the rings received very fine machine work, and found that the extra pains taken paid well, since the arrangement has proved good. Both rings are essentially L-shaped in cross-section, the lower one having an inner, upward projection. In addition, there are six external clamps, held on by screws into the lower ring, and, between the retaining projection and the clamps, the tube end does stay where it is told to stay.

The polar axis is a solid piece of 1¾" steel, the declination axis 1½". Both have thrust ball bearings.

Figure 3 is a 12½" reflector with an $f/5$ Pyrex mirror. Figure 4 is its focogram with very good shadows—for a short focal-ratio mirror. Since there is perennial evidence that, despite warnings in the handbook, "Amateur Telescope Making," many beginners, not to speak of some who are not beginners, are satisfied to judge a mirror merely by visual inspection of the shadows, without actually measuring zones; and since this practice is very likely to lead to the production of over-corrected mirrors, some of them grossly so, readers are warned not to take away with them as a mental standard of shadow *density,* for application to the average mirror, the shadows of this focogram. The shadows are right for this $f/5$ mirror but would be wrong for the average mirror with medium focal ratio. Ellison emphatically points this out in "ATM," page 96. The mere *distribution* of lights and shadows on a mirror is not an adequate criterion of the radii of its respective parts. This point is twice labored here for the benefit of the increased number of younger men — 18 to 22 — who are known to be taking up telescope making today. We have evidence that good mirrors are becoming fewer and farther between, and some think the two facts are related. Middle-aged men are more tenacious and patient, and less inclined to be in a big hurry, and therefore they turn out better jobs. Hence, measure zones—don't merely hope, even if the shadow map looks right. Looks are deceptive; mirrors, too, wear make-up. And refigure, even if it hurts, when the map looks fine but the curve proves to be too deep. On an $f/8$ the shadows will be much greyer and thinner than those of Figure 4.

The 2" polar axis shaft of Hargbol's 12" telescope is mounted on a tapered roller bearing at top and a ball bearing at bottom, the bearings packed in grease and provided with dust covers. The photograph shows the wide, thin fins cast integral with the declination axis casting, making it very stiff—practically as stiff as it would be if the entire envelope were solid, yet much lighter. Hargbol made the patterns and core box and will be glad to pass along to any interested amateur the experience he gained in doing this part of the job.

The triangular spider at top of the

Figure 1: **Hargbol I, 8"**

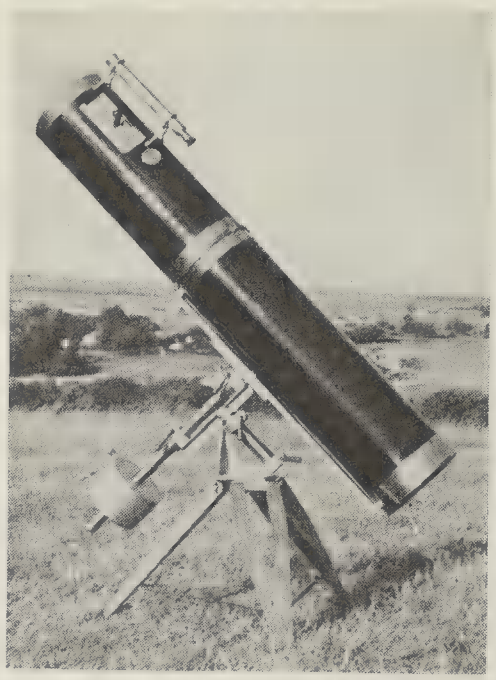

Figure 2: **Hargbol II, 10"**

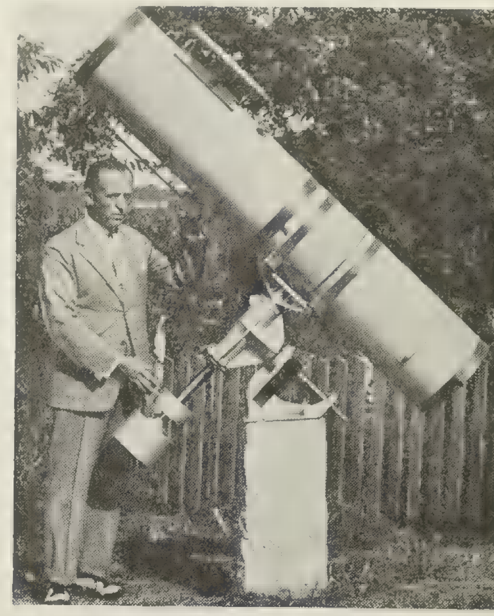

Figure 3: **Hargbol and III, 12"**

Figure 4: **Focogram of III**

declination axis appears in Figure 3 to have an open center, which would mean weakness, but actually it is a casting having a strong central web.

The base casting of this telescope weighs 40 pounds, the declination casting 25 pounds, the tube base weighs 15 pounds, and the counterweight 56 pounds.

TRAUB, not Pope, as stated, was the maker of the observatory dome shown in the October number on page 234. Pope writes to say that he doesn't want credit for another man's work. Ours was the error.

TED WATTERSON, official photographer at Palomar Observatory, Palomar Mt. (Yes, it's now a United States post office), Calif., made the two photographs of the 200" telescope shown in Figures 5 and 6.

Figure 5 shows the upper end of the tube, 20'3" in diameter, cuddled down into the big horseshoe, 46' in diameter, which constitutes the north bearing, and pointing toward the celestial pole. The two oil pads on which the horseshoe floats as it rotates show at left and right. Figure 6 is a close-up of one of these unique pads.

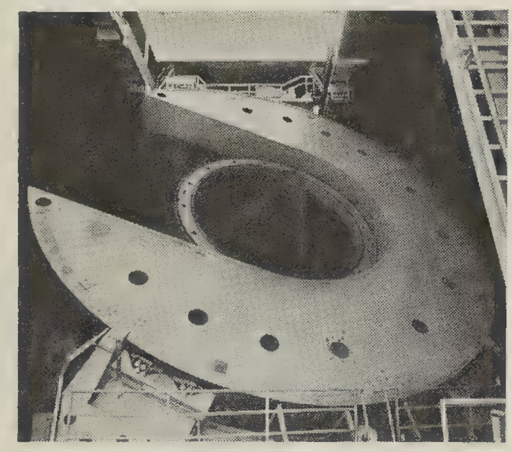

Figure 5: **The 200" telescope**

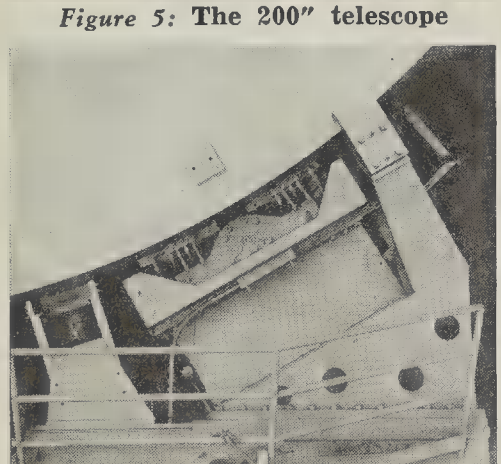

Figure 6: **Oil pad bearing**

Oil is constantly pumped into these pads under pressure. This cuts the torque required to rotate the telescope from 22,000 pound-feet as calculated for roller bearings, to 50 pound-feet. The oil comes up through holes. The pads are covered with babbit metal. The entire pad rests on a knife-edge and each half rests on a spherical seat.

The horseshoe (split ring) bearing is a Porter contribution.

BUBBLES in Pyrex mirror disks cannot be entirely avoided, because Pyrex remains so viscous at temperatures to which it can be raised in melting (about 2800° F.) that the smaller ones haven't enough flotation power to push upward to the top and escape. The manufacturers therefore have to cull the disks over, throwing out the more bubbley ones. Recently, we learn, they have been culling these disks more closely.

If, when the disk is ground, the grinding intersects bubbles, a thin edge is usually created and any fragments breaking loose may scratch the glass. Different amateurs have used various methods of anticipating these troubles and heading them off in time (when the first break-through occurs) by reaming them out. Our file on this subject shows that M. J. Ireland, Dearborn, Mich., used a twist drill and abrasive grains. Edward P. Woodcock, Long Beach, Calif., used the rear end of a twist drill or a rat-tail file with abrasive grains. Lew Lojas, New York, put a round-head screw in a drill brace and similarly used abrasive grains. Woodcock further commented: "Because the bubbles do not materially affect the surface optically, they can do little harm if left alone, provided the edge looks safe from chipping, as in cases where they lie perpendicular to the face."

H. H. Selby, of California, after having some perplexing difficulty with mysterious scratches, found bubbles to be the cause. "After each wet," he says, therefore, "I dried the surface, scrubbed the bubbles hard with a toothbrush and shellac and, after ten minutes, scraped off the excess. During this scrubbing, the brush broke the thin edges of the glass and the shellac sealed in the fragments."

INVENTION of the telescope is generally credited to Jan Lippershay, who in 1608 arranged a convex lens in front of a concave. Bell, in "The Telescope," says Lippershay's telescope was far, however, from being an astronomical instrument. In the following spring Galileo heard rumor of this instrument that made distant objects seem near, sat down and, in one evening, independently figured out an arrangement of lenses which would accomplish this end and it magnified three diameters. Galileo, as Bell states, soon developed this crude beginning into a real instrument of research, magnifying 32 diameters. This telescope is on display in a museum in Florence, behind glass, and your scribe in 1928 slipped the guard there 50 cents to open the case and place a step-ladder before it, so he could climb up close for a little veneration at this fane. Main credit for the invention of the astronomical telescope rightly goes to Galileo; he (1) really made something of it and (2) did important research with it. Moreover, Galileo, not a meek man, fought for his discoveries and gave them publicity, when he could have kept out of hot water merely by being tactful and agreeable. This probably had very much to do with their survival.

While visiting the exhibition of the scientific achievements of Leonardo da Vinci, described on page 332, with Russell Porter, your scribe stumbled on the two grinding machines shown in Figures 7 and 8. If Galileo, who lived from 1564 to 1642, gave us the first astronomical telescope, what was Leonardo da Vinci, who lived from 1452 to 1519, or roughly a whole century earlier, doing with these designs? Porter and Ingalls looked at one another and remarked, "What does it mean?" Were the histories of science then all mistaken? "Better look into that," said Porter, and took a train for California.

The machine in Figure 7 was accompanied by a label stating that it was "a model of a hand-operated machine for grinding a concave lens for a telescope or other instruments." The radius beam on the one in Figure 8 bore the label, in Italian, "Leonardo made this up to 12 meters long." The first machine has a stub lever beneath the bed-plate, with a notch on which a weight could be hung to hold the disk against the grinding wheel, just as it is shown in the photograph. The remainder of the mechanism is obvious. (While the lantern gear may look antique, be it remembered that

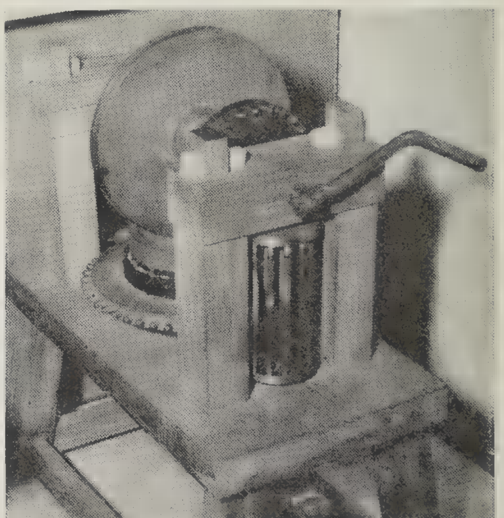

Figure 7: **Design by L. da Vinci**

in Leonardo's time a man couldn't simply turn to the Chicago or Boston Gear Works catalog and select a gear; he had to make his own. Moreover, some of these old gears were not so inefficient as one might think.) The machine in Figure 8 is crank-operated (crank at right-hand end removed in photo) and causes the convex metal sector on the nearer end of the long radius beam to traverse the disk. Evidently the crank man must go into reverse after each two or three turns.

At the offices of the New York Museum of Science and Industry, it was learned that Prof. Georgio Nicodemi, Director of the Department of Fine Arts of the Common of Milan, also Director of Museums in Sforza Castle and an outstanding authority and

writer on Leonardo, had accompanied the exhibition to New York. When hunted up and questioned, through an interpreter, he said that the question of Leonardo's possible priority of invention of the telescope had been the subject of recent discussion in Italy, and he kindly offered to prepare a note summarizing these discussions.

It appears that Prof. Claudio Argentieri has discovered some pages of Leonardo's original notes which have not yet been published. "The most surprising of Argentieri's observations," Prof. Nicodemi writes, "are those concerning the telescope. On folio 25*r*, of Codice F, which is now in the Institute of France, in Paris, Argentieri noticed, under a figure of a large tube mounted on a stand, the words, 'This eyeglass of crystal must be flawless and very clear, and is to be thin in the center.' The note obviously refers to a negative lens. Other notes on the same sheet leave no doubt that Leonardo wished to design a magnifying instrument, and still others explain that one lens was to be plano-convex. Brief writings in Codex E and Codex A [exact references available to any interested reader.—Ed.] indicate that Leonardo intended his telescope for astronomical applications."

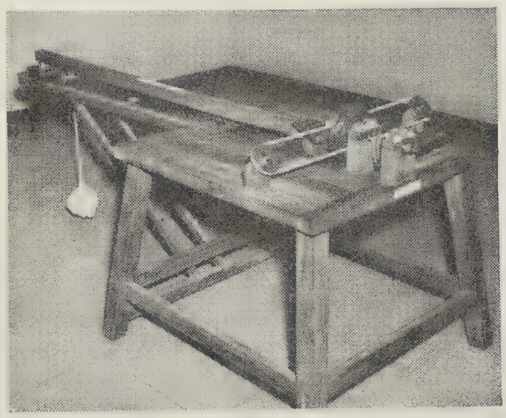

Figure 8: **Another L. da V. design**

Prof. Nicodemi goes on to state that Leonardo improved his telescope by using a concave mirror with a catacaustic curve but without an eyepiece. The machines shown in Figure 8 might have been used for roughing out such a mirror.

Since Leonardo couldn't have used a concave lens alone as a telescope, though he could use a convex, it seems possible that he had used the two in combination—that is, the arrangement now known as "Galilean;" apparently he also used a concave mirror without eyepiece. But in any case, he omitted to publish an account of his telescopes, thus losing credit if this were his due; incidentally, delaying availability of the telescope to the world for about a century.

Whether this would have opened up man's cramped horizons in Leonardo's times, as it later did in Galileo's, and accelerated the Age of Science as much, is, of course, a question. Our guess is that, today, the 200" telescope would be a back number.

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

Labor Labels

JUDGE THOMAS GLYNN WALKER of the Federal Court in New Jersey, in a decision of unusual interest, has restrained the imitation of the label of a labor union.

The suit was filed by a printing-trade union against a corporation bearing the words "Printers Union" in its corporate name. The Court found that the plaintiff was a voluntary association of working men; that it had adopted a distinctive label which was registered as a trade mark for stationery and that it permitted printing establishments employing members of the union to place the union trade mark or label upon its products.

The Court also found that the defendant, despite the fact that its corporate name included the words "Printers Union," was organized and supported by non-union printing establishments; that it had adopted a label which simulated in many respects the union label, and that in one instance the label of the defendant had been mistaken for the label of the printing trade union. The Court found that the simulation of the label constituted trade-mark infringement and that the defendant's entire course of conduct constituted unfair competition.

In reaching its decision the Court pointed out that the defendant had evidenced bad faith by seeking to represent itself as a trade union when, as a matter of fact, it was an organization supported by non-union printing establishments. The Court then pointed out that the defendant, having represented itself as a trade union, "then went a step further and sought to convey the impression that its label was in fact the label of" the plaintiff. It concluded that the use of the word "Union" in the defendant's corporate title, the use of a union label, the use of the words "Union label" and the use of a label deceptively similar to the plaintiff's label, "are with many of the other things herein shown by the record, the parts which, when put together, form the finished mosaic whereby the fraudulent design of the defendant is clearly spelled out."

Non-Exclusive

A NON-EXCLUSIVE licensee under a patent cannot bring suit for infringement of the patent.

This question arose in a rather unusual manner in a Federal Court suit for patent infringement. After the suit was filed, the plaintiff discovered that he did not own the patent but merely held a non-exclusive license under the patent and made a motion to dismiss the suit.

The defendant had filed a counter claim in the suit asking for a declaratory judgment, finding the patent invalid and not infringed, and sought to prevent the dismissal of the suit for the reason that he had incurred a great deal of expense in preparing for the defense thereof.

The Court found, however, that since the plaintiff was merely a non-exclusive licensee, there was no legal controversy between the parties and dismissed the suit.

Technical

WE have previously pointed out that our copyright law is highly technical and requires literal compliance therewith. No portion of the law is more technical than that dealing with the notice of copyright which must be affixed to the copyrighted work. This is exemplified in a recent suit involving copyrighted advertisements.

An advertising agency prepared a series of advertisements to be used by banks. The agency sold the advertisements to subscribing banks who reproduced the advertisements in newspapers and other periodicals. The agency had bound the advertisements in a volume which was copyrighted as a book. Thereafter a bank reproduced several of the advertisements without license or permission of the agency and suit was brought against the bank for copyright infringement.

One of the defenses raised by the bank was that the agency had failed to affix to each copy of the advertisements, which were reproduced and sold, the proper copyright notice required by law.

The copyright law provides in part that every copy of the copyrighted work must contain the required notice and failure to include the notice results in abandonment of the copyright. The law also provides that in the case of a book the required notice shall consist of the word "copyright" or the abbreviation "copr" followed by the date and the name of the copyright proprietor.

In the case of certain works such as prints and pictorial illustrations the law provides that the notice may consist of the letter "C" enclosed within a circle and followed by the initials of the copyright proprietor.

The Court found that the bound volume of advertisements contained the proper notice required by the copyright law for books. However, in actual practice, the advertisements were not published in a volume as a unit, but were separately reproduced and published. The only notice appearing on the individual advertisement was the letter "C" enclosed within a circle together with the abbreviation of the advertising agency and this was so small as not to be legible without the aid of a microscope or glass.

The Court held that this notice did not comply with the requirements of the statute and concluded that the copyright had been abandoned. It was pointed out by the Court that the individual advertisements might well be considered as prints or pictorial illustrations and could have been copyrighted as such. If they had been so copyrighted, the form of the notice would have been proper. Since, however, they had been bound together in a volume and had been copyrighted as a book, compliance with the statute required that the notice should consist of the word "copyright" or the abbreviation "copr" followed by the date and the name of the copyright proprietor.

Rubber Sandpaper

A FLEXIBLE abrasive article similar to sandpaper, comprising abrasive grits or particles, held in a bond of a rubber isomer, was held to be patentable by a Federal Court.

The inventor of the article had applied for a patent and the Patent Office had refused to grant the patent on the grounds that there was no invention involved because prior patents showed it to be old to hold abrasive grits in a bond of raw or vulcanized rubber. The substitution of a rubber isomer bond for the rubber bonds shown in the prior patents, was not considered by the Patent Office to be patentable.

The inventor filed suit in a Federal Court against the Commissioner of Patents and the Court held that the invention was patentable and ordered the granting of a patent. In its decision the Court pointed out that the advantage of using a flexible rubber bond in an abrasive article such as sandpaper had long been recognized. However, prior to the invention under consideration, no satisfactory rubber bond had been developed. Some of the difficulties encountered were that a sufficient bond between the rubber and abrasive particles could not be obtained, and ordinary rubber had a tendency to clog or to become gummy in use.

The Court found that the use of a bond made of a rubber isomer overcame these difficulties and for the first time solved the problem of providing an abrasive article similar to sandpaper in which the abrasive particles were held in position by a satisfactory rubber bond.

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

HOW TO MAKE TALKING PICTURES AT HOME is a completely illustrated description of the Presto Syncro-Sound recorder and its operation. With the equipment described, any amateur movie photographer can produce high-quality talking movies. All accessories are listed and prices are given. *Presto Recording Corporation, 242 West 55th Street, New York City.—Gratis.*

ELECTRICITY AND WHEELS is a 32-page illustrated booklet that presents the fundamentals of electricity and magnetism as applied particularly to the modern automobile. The explanations are given in simple language accompanied by interesting and instructive drawings. *Department of Public Relations, General Motors Corporation, Detroit, Michigan.—Gratis.*

LEAD-TIN-ARSENIC WIPING SOLDER is a five-page discussion of solders and their application to wipe joints which are used in the installation of lead-sheathed telephone cable.—*Bell Telephone Laboratories, Inc., 463 West Street, New York City.—Limited free distribution.*

THE STORY OF SUPERFINISH is a 670-page completely illustrated book, bound with hard covers, that tells the story of this new finishing method for moving parts of machinery. Superfinish, briefly stated, is a method of producing machinery bearing surfaces which will give maximum wearing qualities under heavy-load conditions. *Lynn Publishing Company, 5106 Buckingham Avenue, Detroit, Michigan.—$5.00.*

PLEXIGLAS is a 44-page illustrated booklet that covers the principal properties and more important applications of cast Plexiglas sheet and Crystalite molding powder. Both of these materials are crystal-clear plastics that are finding wide use in a broad range of industries. *Rohm & Haas Company, Inc., Washington Square, Philadelphia, Pennsylvania.—Gratis.*

HYGRADE MIRALUME is a 24-page catalog illustrated in two colors showing a complete range of fluorescent lighting units for business and industry. *Hygrade Sylvania Corp., Ipswich, Massachusetts.—Gratis.*

GE PHOTO DATA BOOK is a 110-page booklet, 3 by 5 inches in size, edited by Karl A. Barleben, F.R.P.S. Packed with technical data of all sorts, including film speed values, flash and flood data, filter data, together with various formulas, the book makes a handy reference that fits nicely into the vest pocket. One of the features of the booklet is an article by Mr. Barleben on "Why and How I Use the G-E Exposure Meter." It also contains a personal exposure record and calendars. *General Electric Co., Schenectady, New York—Free to purchasers of General Electric exposure meter, 50 cents to others.*

SKF SPHERICAL ROLLER BEARINGS is a 36-page catalog that describes and illustrates roller bearing applications in mining, steel, paper, oil, railroad, and allied fields. It also presents information on bearing selection, bearing computations, and various types of roller-bearing design. *SKF Industries, Inc., Front Street and Erie Avenue, Philadelphia, Pennsylvania.—Gratis.*

THE RADIO CONTROL INSTRUCTION MANUAL gives complete data on circuits, systems, and equipment for radio control of models, particularly as applied to gasoline-powered model airplanes. *Radio Control Headquarters, Inc., Granby, Connecticut.—10 cents.*

WHO PAYS THE COST OF HIGHWAYS? is an illustrated booklet that briefly answers pertinent questions regarding highway transportation. It gives direct comparisons with costs in rail transportation. *Association of American Railroads, Transportation Building, Washington, D. C.—Gratis.*

STEEL MAKES THE HOME is a 32-page fully illustrated booklet showing various applications of steel in modern home construction. *American Iron and Steel Institute, 350 Fifth Avenue, New York City.—Gratis.*

GIBSILOY ELECTRICAL CONTACTS is a 16-page catalog which describes a complete line of electrical contacts made from ductile powdered metals. Numerous photographs illustrate various contacts and contact assemblies. Technical data are included. Request catalog C-10 on your business letterhead. *Gibson Electric Company, 8362 Frankstown Ave., Pittsburgh (21), Pennsylvania.—Gratis.*

DEVELOCHROME is an 18-page pocket-size booklet specifically concerned with a new toning developer for use by amateur as well as professional photographers. Using this method it is possible to produce, by direct development, prints in practically any color. *Fink-Roselieve Co., Inc., 109 West 64th Street, New York City.—Gratis.*

THE INSTALLATION AND USE OF ATTIC FANS, by W. H. Badgett, is a 46-page booklet that has been prepared for the use of architects, builders, and home owners. Its scope is limited primarily to residential applications. Profusely illustrated with photographs and detailed drawings, and written in non-technical style. Bulletin No. 52. *School of Engineering, Texas Engineering Experiment Station, College Station, Texas.*

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